





U.S. DEPARTMENT OF AGRICULTURE  
BUREAU OF PUBLIC ROADS

# Public Roads

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3-B ARMY TRUCK—19,000 TRUCKS TURNED OVER TO STATES FOR ROAD WORK

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U. S. DEPARTMENT OF AGRICULTURE

BUREAU OF PUBLIC ROADS

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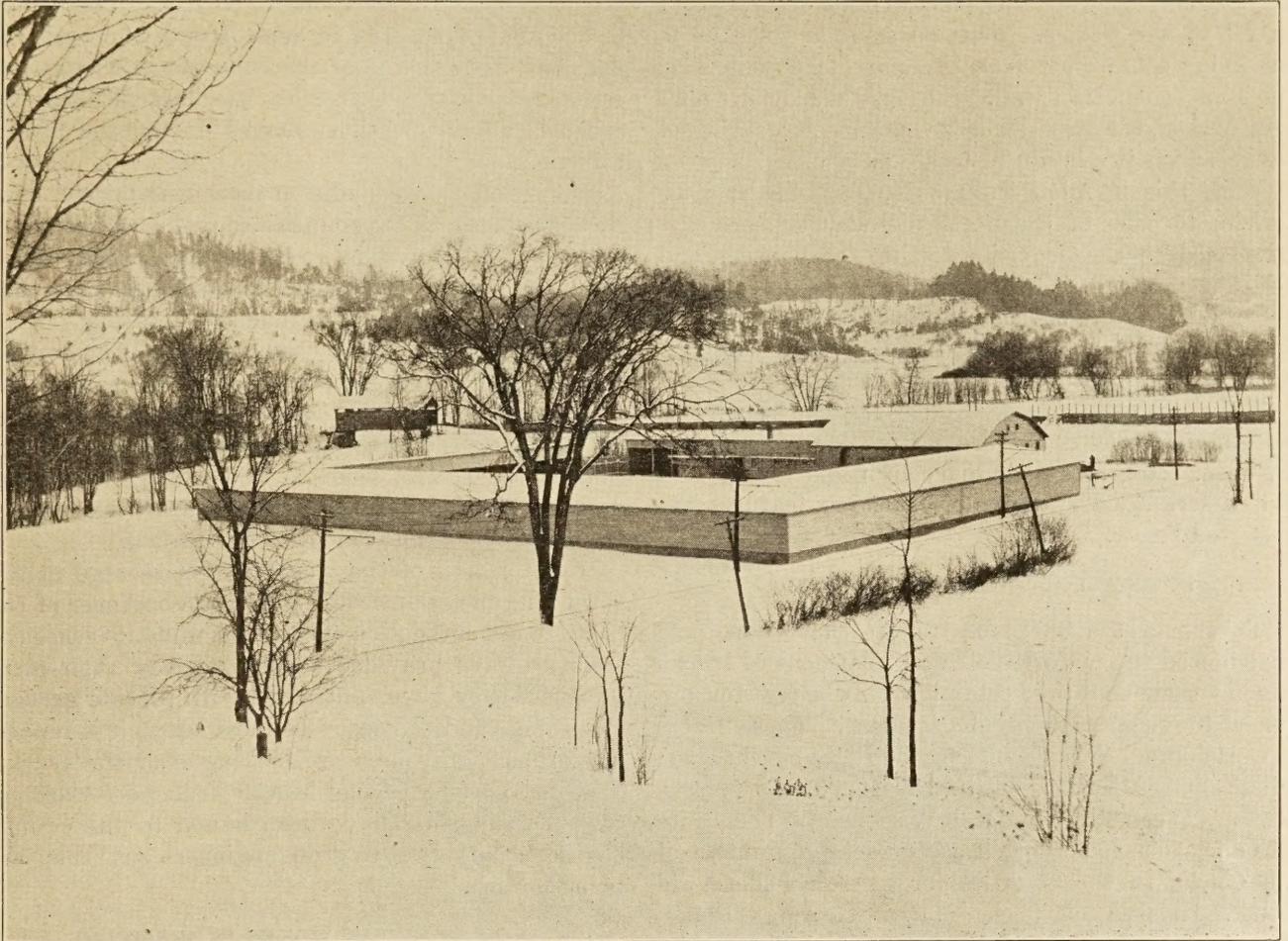
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# HOUSING AND EQUIPMENT OF ARMY TRUCKS BY THE STATES.



BIRD'S-EYE VIEW OF THE STORAGE SHEDS AND GARAGE ERECTED BY VERMONT.

**T**HE distribution of surplus war materials among the several States for use in Federal-aid road construction authorized last year by Congress marked a distinct departure in governmental policy. The action of the Government could not have been long anticipated by the State officials, and it would have surprised no one, therefore, if the early deliveries, particularly the deliveries of motor trucks, had found many of the State highway departments inadequately prepared to receive and care for them.

Many of the trucks had already been exposed to the weather for long periods when they were shipped to the States, and had suffered more or less serious deterioration as a result. Naturally the first concern of the State officials was to provide sufficient shelter to prevent further deterioration. This done, and the opportunity for detailed inspection of their unexpected acquisitions presenting itself, the State

departments were not long in discovering that few of the trucks were suitable for immediate use in highway work. Many of them were found to be deficient in necessary mechanical parts. Some could not be operated at all in the condition in which they were received, and required thorough overhauling before they could be moved under their own power. But even aside from these defects, the majority of them were equipped with bodies entirely unsuited to the work of highway construction.

The problem which many of the States faced, therefore, was the immediate organization and equipment of a plant for the storage, repair, and alteration of a much larger stock of mechanical equipment than their previous plans had ever contemplated. The problem was a difficult one. It was so difficult and so unusual that it is interesting to learn how the several States have solved it. Each State department, with the means at its disposal, and practically

without reference to what was being done along similar lines in other States, has already worked out its own solution. The plans of each have now developed to the point where it is possible to describe some of the more ingenious methods which have been employed and the general lines of procedure in all of the States. Perhaps such a description, involving somewhat of an exchange of experiences, may be beneficial to all. Surely some department will find in the experience of another something of value which it can apply to advantage.

With this in mind PUBLIC ROADS addressed inquiries to each of the State highway departments in regard to the provisions made for housing and repair; the nature of the body alterations which were being made, such as the installation of dumping bodies and hoists; and the cost of such alterations or equipments.

Thirty-eight of the 48 States responded, giving, with more or less detail, statements of their progress to date. A general summary of these replies and full descriptions of the more striking features are reported below.

#### SOME ALLOT TRUCKS TO COUNTIES.

Twelve of the 38 States report that they have distributed the majority of their allotment of trucks among their counties, retaining only a few for the use of the State highway department. These States are Alabama, Arkansas, Georgia, Idaho, Kentucky, Mississippi, Missouri, South Dakota, Texas, Washington, West Virginia, and Wisconsin. The State of Ohio, also, has allotted a considerable number of its trucks to the counties for use on Federal-aid work. In five of these States—Georgia, Idaho, Mississippi, Texas, and West Virginia—the trucks are overhauled and put into good running condition before they are allotted to the counties. The others transfer them to the counties as they are received; but at least one of this latter group—Missouri—has had some trouble in disposing of some of the less serviceable trucks. As the State highway superintendent says, "each of the six division engineers has five or six on his hands that no county is willing to pay the freight and loading charges on." These will probably be repaired by the State.

The condition upon which the trucks are distributed and the degree of control retained by the State appear to vary. Arkansas prescribes that they shall be used by the counties for maintenance work except in the counties in which construction has not advanced sufficiently to make their utilization for maintenance profitable. Such counties are permitted to employ the trucks for construction purposes.

The highway department of Georgia retains full title to the trucks it distributes and requires the

counties to enter into a contract limiting the use of them to such road work as the State department may indicate. The same instrument binds the county to furnish cover for the trucks when they are not in use and to keep them in repair after they are received. In addition to all these conditions the county is required to deposit with the State 10 per cent of the value of the equipment, which it is estimated will cover freight, handling charges, insurance, and inspection charges during the life of the truck.

Idaho and Texas condition their distribution upon the agreement of the counties to make all necessary repairs and to provide covered storage for trucks when not in use. Mississippi exacts the promise that adequate provision will be made for housing.

All the States of this group require the counties to house and repair the equipment they receive, but in the States other than those mentioned the means for enforcing reasonable precautions for the protection of the trucks seem to be lacking, unless the desire of the counties for future allotments of equipment may be employed for that purpose.

Investigation of the conditions of storage in the West Virginia counties by a division engineer of the State road commission shows that in many cases the counties have provided repair shops of their own; in others they have contracted with private garages for storage and upkeep. In most cases, it is reported, former Army men are looking after the trucks. The instructions of the Motor Transport Corps in regard to housing have been issued to the county engineers and the division engineers say they are being followed.

#### HOW THE PLAN WORKS IN MISSOURI.

Reports from 44 counties in Missouri, to which have been allotted 131 trucks, reveal the fact that all have been adequately housed with the exception of one 2-ton Nash. The character of the housing provided for the others varies from what is described as a good shed to newly constructed brick, concrete, or galvanized-iron garages, many of them with concrete floors and well-equipped repair shops attached. On page 7 are shown exterior and interior views of the garage constructed by Jasper special road district in Jasper County. The wooden structure has a corrugated galvanized-iron roof and a 6-inch concrete floor of sufficient area to accommodate sixteen 3-ton trucks. There is a door at each end of the garage, which does away with the necessity of backing either in or out of the building.

Many of the trucks have been equipped by the counties with special bodies suitable for their work. These are of all types, from simple wooden dump beds, installed at a cost of only \$25 per truck, to modern steel dump bodies with hydraulic hoists,

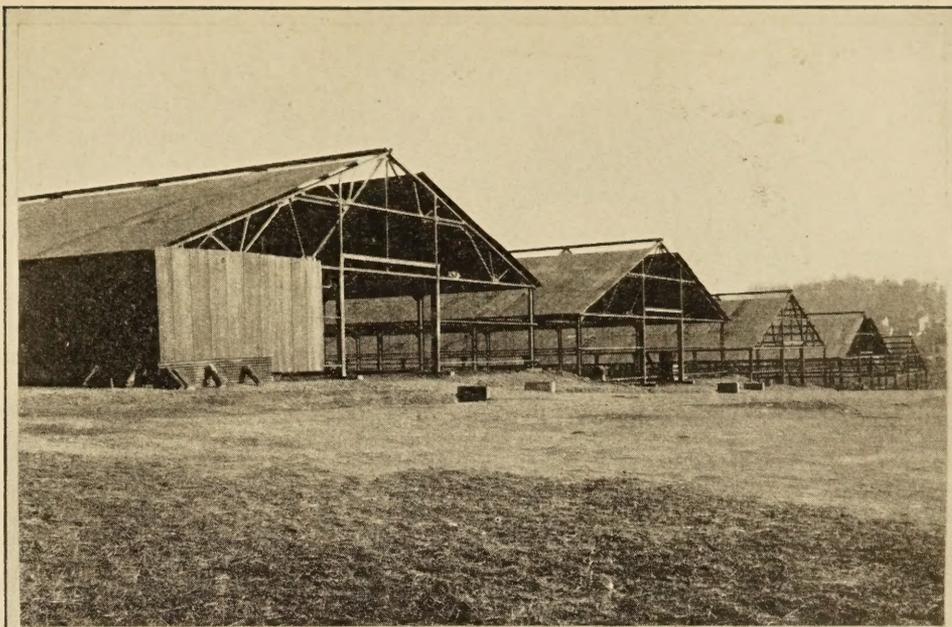
which cost \$784. A few of the trucks have been equipped with water tanks, at a cost of \$180, for use in macadam road construction. The type of dump body and hand hoist installed in the Hollister-Kirbyville special road district in Taney County is an inexpensive one, the cost being but \$275. The type is shown in the illustration on page 13. The garage in which the truck is housed is shown in the background.

A number of the counties are using the trucks just as they are received; and one county, which plans to install special bodies, has asked the State department to give it assurance that the equipment will be permitted to remain in the county before it undertakes the expense.

Nearly all counties report that the trucks have been placed in care of expert mechanics, and all but a few report that the cost of repairs has so far been very light. General satisfaction with the performance of the equipment is expressed in all reports, one county going so far as to add that its allotment of two 2-ton Nash trucks has saved it \$1,000 during 1919.

#### RENTS TRUCKS TO CONTRACTORS.

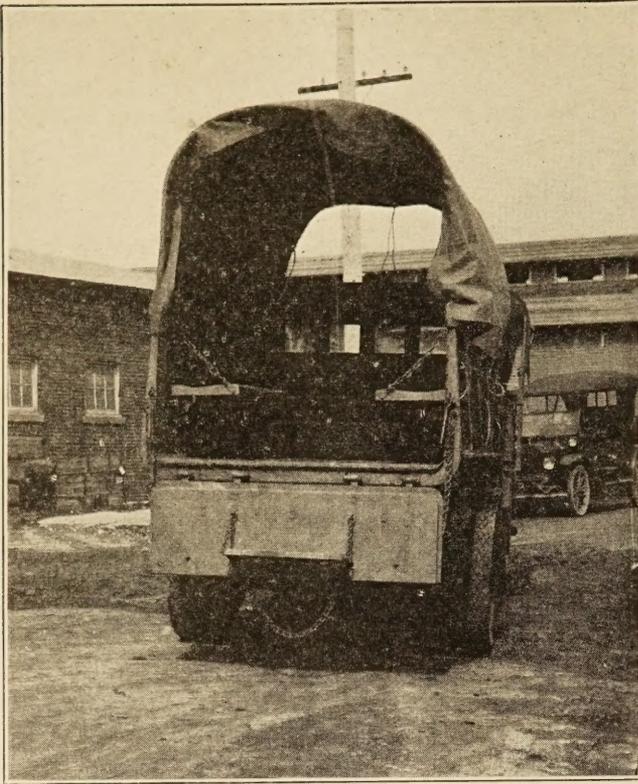
Trucks which are assigned to counties by the Wisconsin highway commission must be housed and kept in repair by them. Many of the counties already had garages, and those which were not so fortunate have arranged to house the equipment in county fair buildings or in rented space in private garages. In the work of repairing the trucks the counties have the assistance of the mechanical department of the State commission, which keeps a large stock of parts on hand for such work. Parts called for by the counties which are not on hand are purchased direct from the manufacturer and shipped



ABOVE, PENNSYLVANIA'S GARAGES IN COURSE OF CONSTRUCTION. BELOW, TILE GARAGES BUILT BY IOWA.

from the factory to the county, but in the future the commission proposes to furnish all parts itself.

About 120 trucks in all have been assigned to the counties. The balance of the State's allotment is maintained by the mechanical department for rental to contractors and counties for use on Federal-aid projects. These trucks are rented on condition that the parties who rent them will make all necessary running and service repairs, but the mechanical department renders some assistance by furnishing parts and mechanics to make repairs when called upon. At the end of the season all rented trucks are taken to one of the State's repair shops for thorough overhauling. The main repair shop is at West Allis,



LIGHT AVIATION TRUCK EQUIPPED TO TRANSPORT LABORERS.

Wis., and has been fitted up with machinery, hoists, a blacksmith shop, and other equipment necessary for general overhauling work. The other shops are operated in connection with local garages in other parts of the State.

During the coming season about 50 trucks will be rented without bodies. On these chassis the contractors will mount platform beds, but practically all others will be equipped with hoist and dump bodies. Three types of hoists have been used so far—one a hand hoist and the others hydraulic hoists. Views of these types are shown on pages 9, 13, and 16.

The actual cost of installing the hydraulic hoists and 2-cubic-yard dump bodies is \$525, including the war tax. The cost of the same hoists and 3-cubic-yard bodies is \$575. So far these bodies have been mounted only on 2 and 3 ton trucks. On page 6 is shown a light aviation truck equipped with a canvas top on bow frames, and longitudinal seats accommodating 15 men, which is used for the transportation of field parties and laborers.

#### IDAHO INSTALLED HOPPER BODIES.

Idaho has developed a type of hopper body, with a hand-dumping device, which it has installed on the Nash quads which are equipped with steel ammunition bodies, at a cost of only \$85 per truck. An interior view of one of these bodies, disclosing the dumping device, is shown on page 21, and on page 8

are given detailed plans for the construction of this body.

Before the Mississippi trucks are distributed to the counties they are put into good running condition and are equipped with standard steel dump bodies with hand hoists. All trucks are painted uniformly, with the name of the State department and a serial number lettered on the sides of the body. All this work costs approximately \$500 per truck, but the Mississippi officials are confident that the money is well spent. On page 9 is shown a truck equipped with one of the standard bodies in the elevated position.

#### COUNTY ALLOTMENT UNSATISFACTORY.

After a trial of the plan of allotting the trucks to its counties, the department of State lands, highways, and improvements in Arkansas finds that it does not work satisfactorily. Officials of the State department are convinced that a maximum of usefulness can not be secured from the trucks by this method. Accordingly, they plan in the future to lease all equipment received from the War Department to contractors and commissioners for use on specific road projects. In this way they hope to place the trucks where they will be of the most use and of the greatest benefit to the State as a whole. In reaching this decision to rent the trucks they are following the same course which has been adopted in Wisconsin, Iowa, Illinois, Montana, and perhaps other States.

The States previously referred to allot the majority of their trucks to counties. The rest from which reports have been received employ practically all of their equipment directly under the control of the State highway department, or by lease to contractors, on State road work. The States of this group are: Colorado, Connecticut, Delaware, Illinois, Indiana, Iowa, Maine, Maryland, Massachusetts, Michigan, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, North Dakota, Ohio, Oregon, Pennsylvania, Rhode Island, Tennessee, and Utah.

#### HOUSING OF TRUCKS BY STATES.

The problem of housing the trucks retained by the States is naturally a much more difficult one than that with which the counties have had to deal because of the greater number of trucks which must be provided for, but, except in two or three of the States of this group, all equipment received from the Government had been adequately housed by January, 1920. The provision which has been made in the several States varies considerably in character. Seven of them, temporarily at least, are employing buildings on State fair grounds. One State has taken over an abandoned street-car barn; one an abandoned motor-truck plant; one State uses an old

stable which has been converted into a garage and repair shop; two States have rented buildings suitable for the purpose; one State has arranged for a large frame building; two are storing in private garages; and at least six have well-designed buildings completed or under construction for the special purpose of housing their trucks.

#### TILE GARAGES ERECTED IN IOWA.

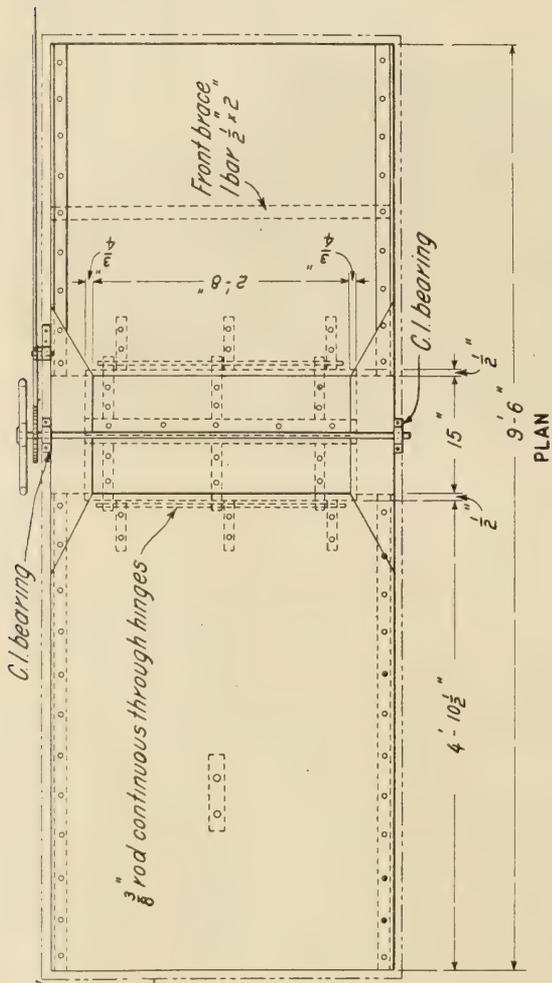
Iowa has practically completed the construction of four buildings, each 52 feet 6 inches wide by 142 feet 6 inches long, for the storage of its allotment of trucks. The walls, 12 feet high from floor to eaves, are of hollow tile, stiffened by brick columns at frequent intervals. In one end of one of the buildings provision has been made for a repair shop, 50 feet wide by 60 feet in length; and connecting with this shop by a large door there is a "parts" storage room 27 by 50 feet. The repair shop and parts room have concrete floors. All other parts of the building have cinder floors. The buildings to be used for the storage of trucks are provided with doors so arranged that any truck can be taken out by moving not more than one other truck. This is an exceedingly important feature of the design of such buildings and one which it will be well that other States bear in mind in connection with the design of their housing facilities. In addition to the four buildings described, Iowa has arranged for the use of the State fair buildings at Des Moines, in which a large number of trucks are stored. However, it is hoped that four additional buildings of the type described will be built during the coming season, thus enabling the highway commission to store all of its equipment at Ames. An exterior view of the new buildings is shown on page 5.



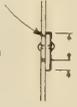
INTERIOR AND EXTERIOR VIEWS OF GARAGE IN WHICH ARE HOUSED THE TRUCKS ALLOTTED TO JASPER SPECIAL ROAD DISTRICT, JASPER COUNTY, MISSOURI.

#### THREE STATES STORE IN SHEDS.

Utah's provision for the trucks is radically different from that of Iowa, but apparently none the less effective. A large shop building of concrete, with windows occupying practically the entire wall area, has been erected to house its very complete equipment of machine tools and forging apparatus. The machine shop section contains a traveling crane, drill presses, lathes, planers, and practically every device necessary for the repair of the trucks, and the forge shop is correspondingly well equipped. All machinery is electrically driven. For storage the commission has built a stockade inclosing a yard  $5\frac{1}{4}$  acres in area, around two sides of which



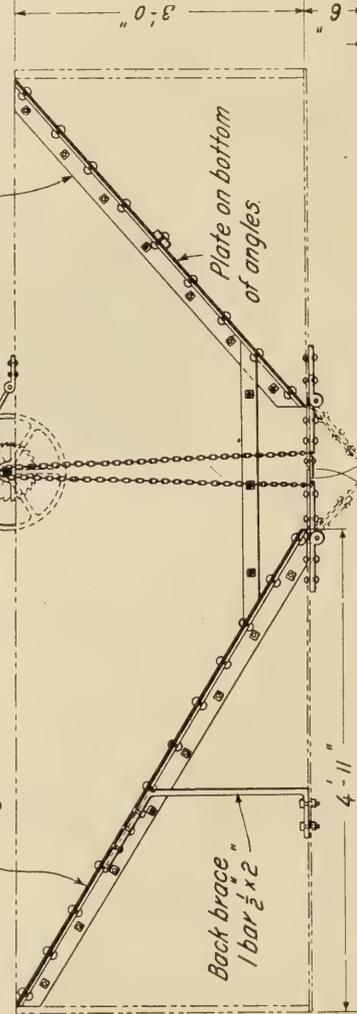
Hole in bottom of truck 15" x 2'-8". Doors extend  $\frac{3}{4}$ " beyond edge of hole at end and  $\frac{1}{2}$ " at side. Bar 3" x 2'-9  $\frac{1}{2}$ " x  $\frac{1}{2}$ " riveted on one edge of door.



All parts fastened to truck body with  $\frac{3}{8}$ " bolts  
 One cubic yard of gravel approximately within one foot of top of truck  
 Two cubic yards of gravel approximately within one inch of top of truck  
 Two tons of gravel approximately within six inches of top of truck.

Chains fastened to axle by eye bolts at right angles.

$\frac{1}{4}$ " plate riveted to 2" x 2" x  $\frac{3}{8}$ " Ls with 12- $\frac{3}{8}$ " rivets in each L and bolted to truck with 8- $\frac{3}{8}$ " bolts.



Drop doors fastened by three strap hinges. Edges of door extend  $\frac{3}{4}$ " beyond edge of hole.

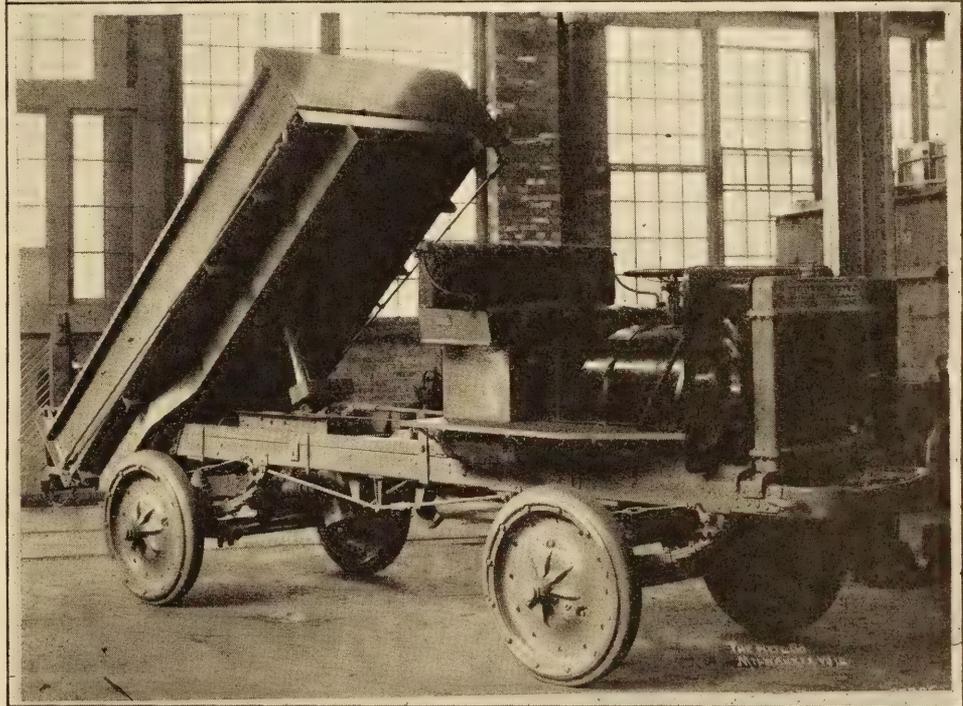
Operators platform - 2'5" x 4'12" x  $\frac{1}{2}$ " - 2" wide, 1'-0" apart bolted to truck by 4- $\frac{3}{8}$ " bolts and 1 board 1" x 12" x 2'-6" bolted to its by 4- $\frac{3}{8}$ " bolts.

wooden sheds have been constructed to shelter the machines. There is space in the sheds for the storage of about 50 trucks. While this method of storage is probably not desirable for trucks which are to remain idle for long periods, such as during the winter, it is entirely adequate for trucks which are in active service. The entire plant, including shops and stockade, views of which are shown on pages 17 and 19, cost approximately \$50,000.

Vermont's plant, which is similar to that of Utah, is constructed on a 5-acre lot which the State has bought on the State road and trolley line between Montpelier and Barre and just beyond the city limits of Montpelier. The present buildings, shown on page 3, consist of a garage 48 feet wide by 64 feet long; a machine shop, 24 feet square; a storeroom for supply parts with floor dimensions of 24 and 60 feet; a power plant, 18 by 30 feet in size; and the sheds built inside the stockaded inclosure, containing 47 stalls, the majority of which are 10 feet wide by 23 feet 6 inches deep. All buildings and sheds are of frame construction. It is also intended to build a caretaker's house in connection with the garage, but this work will not be done before the coming summer.

To cover the cost of this plant, as well as the expense of freight shipment and repair of the trucks and other surplus war material, the board of control has apportioned \$75,000 to be used in addition to other available highway funds.

The Montana plans include a tile machine shop, which is now nearing completion at Deer Lodge, and shed room for 40 machines. The shop building will



ABOVE, MISSISSIPPI TRUCK EQUIPPED WITH STANDARD BODY AND HAND HOIST. BELOW, VERTICAL HYDRAULIC HOIST ON A WISCONSIN TRUCK.

be 120 feet long by 40 feet wide, and will include a storeroom for parts and supplies, 20 feet wide by 18 feet long. At present a large number of trucks are housed in a stockade 150 feet wide by 200 feet long, with a 20-foot shed around three sides, and the balance are outside, with the axles blocked up to lift the wheels from the ground.



SIMPLE SIDE-DUMPING WOODEN BODY INSTALLED IN MAINE.

#### PENNSYLVANIA AND MAINE PLANS.

Pennsylvania's storage facilities are not yet ready for use. However, the State highway department has contracted for the erection of five large buildings constructed with steel frames covered with corrugated galvanized-iron siding and roofing. These buildings are now under construction, and some idea of the general layout may be obtained from the upper view on page 5.

Maine has not progressed as far as Pennsylvania in preparing for the permanent storage of its trucks, but the elaborate plans which have been prepared give promise of a most useful plant when it is completed. A central garage and service station will be erected at Augusta early this season, and it is probable that at least two and probably four substations will later be erected at other points in the State. The Augusta plant will include a two-story fireproof shop building of concrete and steel construction and at least two garages. The site of the shop lies at the edge of a bank, which makes it possible to provide a street entrance to both floors. Each floor will have an area of 100 square feet. The lower floor will be partly underground, and will be used entirely for dead storage, with the exception of a small room reserved for the heating plant. On the second floor there will be an office 16 feet square, a combined parts stock room and tool room 30 feet wide by 60 feet long, and the rest of the floor will provide space for repair work. The two garages will be 150 feet long by 50 feet wide, and will be built to face each other with a common driveway 50 feet wide running between them, along their long dimension. Opening on the common driveway will be a series of doors, which will make it possible to reach any truck stored in either build-

ing by moving only the truck in front of it, and it will permit the moving of half the trucks without disturbing any others. Eventually the storage space can be expanded by the erection of another building 150 or 200 feet long and 50 feet wide. The plan also contemplates the erection of a paint shop 50 feet square, adjoining and communicating with one of the storage garages, which seems to indicate that the Maine commission intends to keep its equipment in good order.

#### HOUSING IN OTHER STATES.

Other States which have not announced plans for the construction of new buildings especially designed for the housing of the trucks have nevertheless made adequate provision for their shelter. Illinois, Indiana, Nebraska, Ohio, and Oregon have arranged to house all their equipment at State fair grounds; and New Jersey and North Dakota have made this arrangement for a part of their equipment. New Jersey has installed most of its equipment in a building which it has leased for the purpose, in connection with which it has a well-equipped shop. North Dakota houses the balance of its allotment in private garages. A similar arrangement has been made in Connecticut and Maryland. Colorado has converted an abandoned car barn; Michigan uses an abandoned motor-truck manufacturing plant; New Hampshire has converted an old stable; Tennessee has acquired a large frame building in good condition; and Rhode Island has rented facilities for the purpose.

#### CONDITION OF TRUCKS RECEIVED.

Very few of the State officials comment on the condition of the equipment received. A few, however, refer to the fact that some of the trucks and tractors were in bad condition when they arrived at their destination. The highway commissioner of South Dakota described the condition of his allotment of used tractors as "very bad \* \* \* , largely due to carelessness," adding "that tractors loaded in Florida were not drained and reached their destination frozen solid, with the usual results." Both Delaware and Connecticut have found three or four of their allotment to be in unserviceable

condition. But that this condition is not at all general is shown by a tabulation submitted by the highway commissioner of Vermont, which gives a statement of the garage expense of the trucks before they were put into service. In the case of one truck this expense was only \$7.80. The greatest expense for any truck was \$20.14, and the average expense for 17 trucks was only \$13.61. West Virginia estimates the cost of conditioning at \$75 per truck.

#### BODY ALTERATIONS MADE BY STATES.

It has been the general opinion of State officials that the bodies with which the trucks were equipped for Army use are not suitable for road work. Accordingly, nearly all of them have made plans for the alteration of the Army bodies or the installation of entirely new bodies and hoisting apparatus, and a great many trucks have already been thus reequipped.

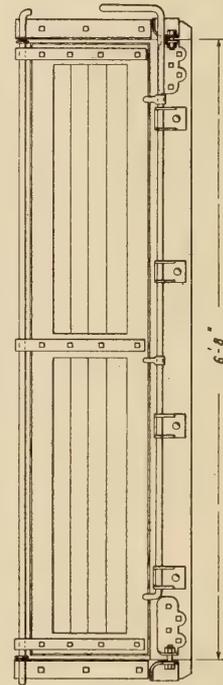
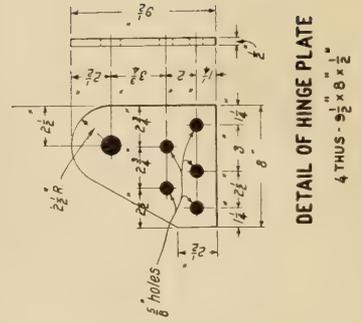
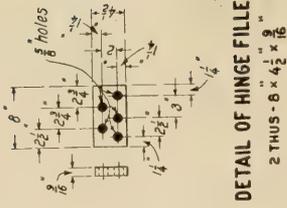
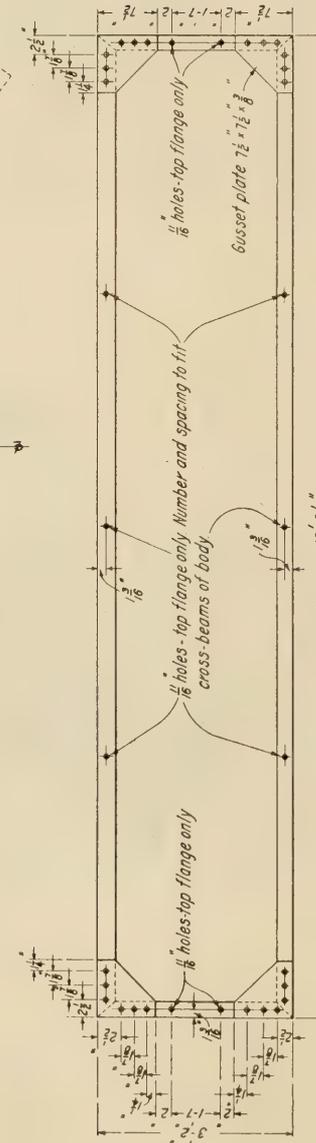
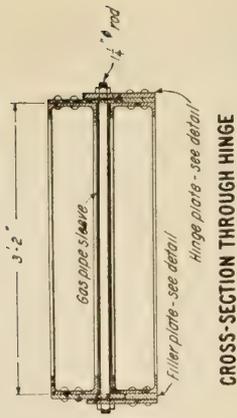
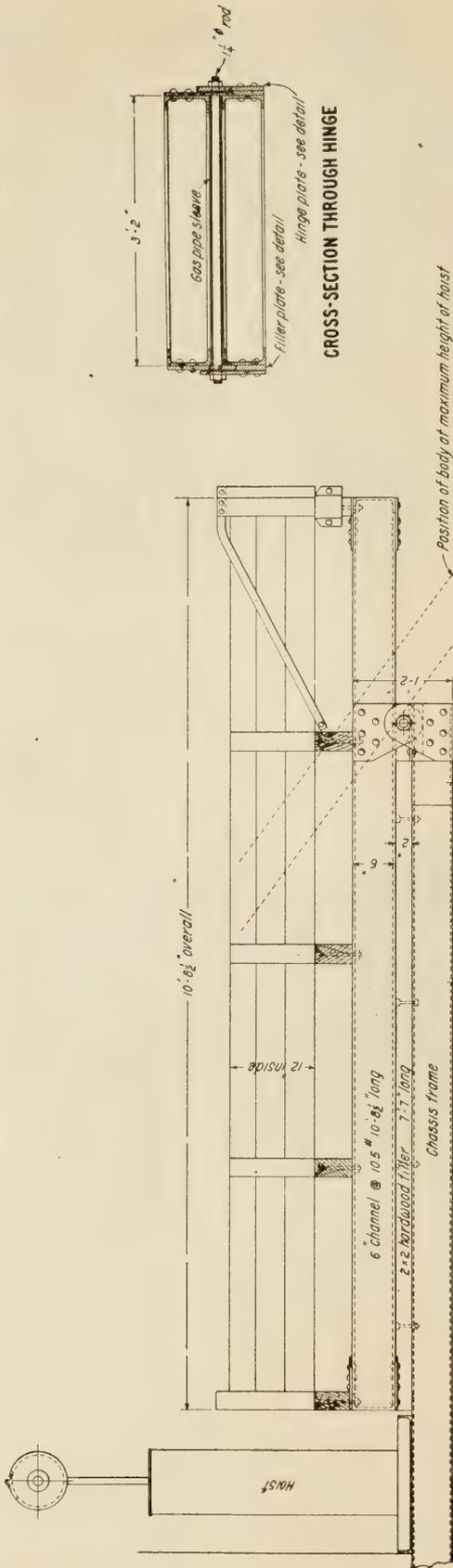
By far the larger number have been equipped with stock bodies made by various manufacturing concerns, and such trucks, in general, are also provided with patented hoisting apparatus to dump the body. Several types of such bodies and dumping apparatus are shown in the illustrations. The hoists in use for elevating the bodies are operated by hand or by hydraulic pressure. Hydraulic hoists are made in three principal patterns, two of which carry the cylinder under the body and differ mainly in the detail that the cylinder of one is hung in the vertical position and that of the other is placed horizontally. Views of these types are shown on pages 9 and 16. The third type of hydraulic hoist, shown on page 13, consists of a cylinder and plunger set up vertically between the cab and the body, the body being hung to the plunger by means of cables. The cables, slung over two pulleys at the end of the plunger



ABOVE, 2-TON INTERNATIONAL TRUCK AS RECEIVED FROM THE GOVERNMENT. BELOW, THE SAME TRUCK CONVERTED INTO A SURVEY CAR BY THE MARYLAND STATE ROADS COMMISSION.

shaft, eliminate the effect of eccentricity of load. Typical hand hoists, which have been applied to more trucks than any of the hydraulic hoists, are shown on pages 9, 13, and 23.

Some of the States have not had sufficient funds to install the elaborate equipment supplied by commercial body builders. Iowa, for example, has been able to equip so far only seven of its trucks because of a lack of authority to spend money for the



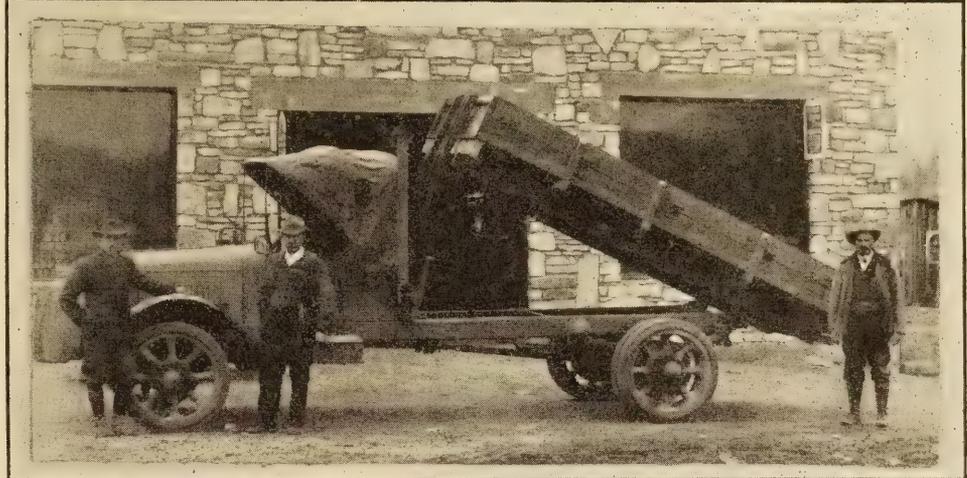
purpose. In this case the State expects to pay for the necessary equipment from the earnings of the trucks it will rent during the coming season. In other cases it has been thought desirable to devise ways to convert the bodies with which the trucks are equipped when they are received or to build single bodies to replace them. Many and interesting are the devices which the several States have put into use with this thought in mind.

One of the simpler forms of dump body is the type which has been used to some extent in Alabama, West Virginia, Tennessee, and Maine. A V-shaped ridge running lengthwise of the truck is built inside the standard cargo body, the sides of the ridge sloping to the bed of the box at the sides. Then all that remains to be done is to hinge the sides of the cargo body either at top or bottom, and the result is a side-dumping body at a cost which may be \$20 or \$50, but, at any rate, is very small. The usefulness of the body thus converted may be enhanced by lining the inside of the body and covering the ridge with sheet metal, which will cause the load to run off the sloping bottom more rapidly.

A view of this arrangement as used in Maine is shown on page 10, and a variant form used in Vermont is shown on page 20.

The hopper body with hand-operated bottom dump, into which Idaho has converted the steel ammunition bodies on Nash quads, has already been described. The cost of this alteration is only \$85, yet it would seem to suffice for many purposes as well as much more expensive equipment.

Maine has devised a scheme of altering the standard cargo body furnished on the Packard, Peerless, and heavy aviation trucks somewhat as follows: The sideboards are cut down to 12 inches in height; a swinging tailboard hinged at the top, with provision for opening from the seat, is added at the rear, and the entire body is lined with sheet steel of 9 or



ABOVE, VERTICAL HYDRAULIC HOIST AND DUMP BODY INSTALLED BY WISCONSIN. BELOW, CONVERTED CARGO BODY AND HAND HOIST INSTALLED BY HOLLISTER-KIRBYVILLE SPECIAL ROAD DISTRICT, MISSOURI, AT COST OF \$275.

10 gauge. The front end of the body is cut off some 18 or 20 inches to allow room for mounting a hydraulic hoist between the cab and the front of the body as cut down. Cutting the body at the front end preserves the proper relation between the cross members of the body and the wheels. The cross members of the original body are bolted to a lifting frame, made up of 10½-pound 6-inch channels, which is hinged on a 1¼-inch pin at the rear of the chassis frame. A 2 by 2 inch hardwood filler is bolted to the top of the chassis and supports the lifting frame in the normal position. All these details, with full dimensions of the critical parts, are shown on page 12. A similar arrangement, employing a hand hoist and wooden underframe, is shown on this page. It is estimated that the cost of making the body changes indicated will be about \$150 per body. This does not include the cost of the hoist.

#### SPECIAL TYPES OF BODIES APPLIED.

Some of the States have equipped the trucks with bodies designed for special purposes. For example, New Jersey has converted an ambulance into a sur-

vey car; Maryland has accomplished much the same result with a 2-ton International as raw material. The truck before and after alteration is shown on page 11. By simply installing seats in the ordinary cargo body and covering the box with a bow frame and canvas cover, New Jersey prepares a vehicle for the transportation of State convicts to and from the prison in Trenton.

Massachusetts has added tanks and pressure spraying devices to 12 of its allotment; and New Jersey and Delaware have equipped a number of trucks with snowplows and are fully satisfied with the result.

#### COST OF EQUIPMENT.

The cost of the changes which the States are making in the trucks as received varies from about \$20 to over \$700 per truck for the various forms of body, dumping apparatus, etc. The forms of alteration and equipment are so numerous and variable that it is impossible to describe them all, so they have been listed in the table below, and the actual or estimated cost of each form of equipments has been given whenever the information is available.

*Types of truck body alteration and equipment, with costs, as reported by various States.*

State.	Description of body equipment.	Cost per truck.
Alabama.....	No accurate data.....	\$25.00-\$500.00
Arkansas.....	do.....	
Colorado.....	2-ton dump body and horizontal hydraulic hoist.....	571.50
	3-ton dump body and horizontal hydraulic hoist.....	663.60
	3½-ton dump body and vertical hydraulic hoist mounted at front of machine.....	787.00
Connecticut.....	2-ton dump body and hand hoist.....	311.25
	3-ton dump body and hydraulic hoist.....	797.00
	Inclosed cab (installed).....	130.00
Delaware.....	2-ton dump body and hydraulic hoist.....	500.00
Georgia.....	2-ton dump body with vertical hydraulic hoist installed at front of machine.....	526.50
	3-ton dump body with vertical hydraulic hoist installed at front of machine.....	576.90
Idaho.....	2-ton dump body with horizontal hydraulic hoist.....	650.00
	Hand-dumping, hopper body, 2-ton (improvised).....	
Illinois.....	2-ton dump body and hydraulic hoist.....	525.00
	3-ton dump body and hydraulic hoist.....	575.00
Ohio.....	2-cubic-yard dump body with hydraulic hoist.....	450.00
	3-cubic-yard dump body with hydraulic hoist.....	470.00
Iowa.....	Dump body.....	150.00
Kentucky.....	No accurate data.....	
Maine.....	A-frame wooden body.....	35.00
	Altered cargo body with vertical hydraulic hoist mounted at front.....	450.00
	Altered steel ammunition body with vertical hydraulic hoist mounted at front.....	500.00
Maryland.....	No data.....	
Massachusetts.....	Dump body and hydraulic hoist.....	700.00
	Tank and pressure spray.....	1,000.00
Mississippi.....	Steel dump body and hand hoist.....	500.00
Michigan.....	Dump body and hydraulic hoist.....	590.00-750.00
Missouri.....	Wooden A-frame dump body.....	47.00
	Steel dump body and hydraulic hoist.....	784.00
	Water tank on Nash quad.....	180.00
Montana.....	2-cubic-yard dump body and hydraulic hoist.....	620.00
	3-cubic-yard dump body and hydraulic hoist.....	760.00
Nebraska.....	Sloped bottom wooden body.....	150.00
	Altered ammunition body and hydraulic hoist.....	650.00
Nevada.....	Dump body and hoist.....	580.00
New Hampshire.....	2-ton dump body and hand hoist.....	175.00-350.00
	3½-ton dump body and hydraulic hoist.....	500.00-700.00
New Jersey.....	Steel dump body and hoist.....	600.00
	Snowplow attachment installed.....	300.00
New Mexico.....	Dump body with hydraulic hoist.....	412.00-430.00
New York.....	3-ton dump body and hydraulic hoist.....	600.00
North Dakota.....	No data.....	
Ohio.....	do.....	
Oklahoma.....	do.....	
Oregon.....	2-ton dump body and horizontal hydraulic hoist.....	425.00-475.00

*Types of truck body alteration and equipment, with costs, as reported by various States—Continued.*

State.	Description of body equipment.	Cost per truck.
Pennsylvania.....	35-cubic-foot dump body and hand hoist.....	\$313.00
	54-cubic-foot dump body and hydraulic hoist.....	\$540.00-560.00
Rhode Island.....	2-ton dump body and hand hoist.....	300.00
	3-ton composite body and hydraulic hoist.....	722.00
South Dakota.....	2-ton dump body and hydraulic hoist.....	550.00
	3-ton dump body and hydraulic hoist.....	600.00
Tennessee.....	A-frame wooden body.....	20.00-55.00
	Steel dump body and horizontal hydraulic hoist.....	715.00-750.00
Texas.....	No accurate data.....	
Utah.....	Altered Nash quad body with hand hoist.....	265.00
	3-ton steel dump body and hydraulic hoist.....	717.00
Vermont.....	Altered Nash quad body with vertical hydraulic hoist mounted at front.....	394.00
	Side discharge wooden body for Nash quad.....	135.00
Washington.....	No accurate data.....	
West Virginia.....	2-ton dump body and hydraulic hoist.....	630.00
	3-ton dump body and hydraulic hoist.....	690.00
Wisconsin.....	2-cubic-yard dump body and hydraulic hoist.....	525.00
	3-cubic-yard dump body and hydraulic hoist.....	575.00

#### PENNSYLVANIA ROAD WORK.

In 1919 the State highway department of Pennsylvania completed construction work on 253.1 miles of durable highway and 41.58 miles of uncovered base. During the year contracts were awarded for 685.02 miles of durable road of various type, of which 179.74 miles were entirely completed by the close of the season. Contracts were carried over from 1918 for 95.47 miles, of which 73.36 miles were completed during 1919. Many miles of the new road building under the 1919 contracts will be completed early this year, as grading and drainage have been finished and materials for the uncompleted work are largely on the ground.

Contracts to be let during 1920 will run up to about 800 miles, and the policy is to let them at as early a date as possible so work can be started as soon as the weather and other conditions permit.

#### NEW YORK HIGHWAYS.

The Chamber of Commerce of the State of New York has approved a report of its committee on the construction of State highways and submitted it to the governor and the legislature. It favors the adoption of a complete system of State highways, new roads and improvements of old roads to be made with the most durable material known to engineering science. The main factor to be considered in road improvement is the annual cost of maintenance. A complete system for New York, the report holds, should consist of 13,000 miles, which, if constructed of the best material, would represent an annual cost for maintenance of \$3,500,000, or \$250 a mile. This is \$750 less than the present average cost of maintenance. To create such a system there must be spent \$167,000,000 in the construction of 4,175 miles of new roads and \$36,000,000 for placing existing highway mileage in first-class condition.

# HANDLING FEDERAL EQUIPMENT AFTER ITS RECEIPT BY STATES.

ROLLEN J. WINDROW, State Highway Engineer of Texas.

**W**HEN we were notified by the Chief of the Bureau of Public Roads that Congress had authorized the Secretary of War in his discretion to transfer to the Secretary of Agriculture for distribution among the States all available war material, equipment, and supplies not needed for the purposes of the War Department, but suitable for use in improvement of highways, little did we realize the magnitude of this appropriation and the far-reaching effect of the provisions of this act on the road-building undertaking throughout the country, nor did we fully appreciate the tremendous job with which we were confronted in receiving and distributing this vast amount of equipment among the various political units of the State of Texas.

The importance which this appropriation of equipment bears to the road building program of the various States may vary, depending on the financial and material resources of the several State highway departments, but as the basis of distribution is the same as for the distribution of Federal aid, and each State is assured of its proportionate share, it goes without saying that this is a matter in which every State is vitally interested.

In discussing the receiving and distribution of this equipment, organization methods, and rentals, I am forced to recount largely the way in which this is handled in my own State.

## BASIS OF OPERATION.

The highway departments of the various States operate on two different bases. In some dozen or more States the State highway department has the initiative in all matters pertaining to the construction and maintenance of their State highways, or, in other words, the highway departments in these States have actual charge of the engineering and construction work. In the other States which constitute the large majority the initiative in State highway work rests with the county, parish, or township, and the State highway department functions only in a cooperative or supervisory capacity.

The use, therefore, of this equipment is on a different basis in the different States, but certain it is that this equipment does not further the road building program until it is put in the hands of the operator, whether that operator be the construction division of the State highway department or whether it be the county, parish, or township. In Texas the county is



ROLLEN J. WINDROW.

the operator, and therefore our organization and plan for handling this equipment has been formulated with the main idea of getting it in the hands of the counties as soon as possible and with the least possible expense.

In this discussion it is well to divide the Federal equipment into two general classes, which in most cases are to be considered and actually handled separately. Obviously, these two classes are: First, trucks; and second, all other equipment. At present the allotment of trucks constitute the bulk of the Federal equipment distribution.

If the distribution of trucks goes through as already allotted the needs of the various States will be satisfied to considerable extent, if not wholly so; but trucks constitute only one item of equipment that is used in highway work. While our needs for trucks may be largely supplied, it is useless to expect that we will receive all we need of other such items as portable crushers, road graders, steam shovels, rollers, tractors, concrete mixers, locomotive cranes, industrial track, and the hundreds of other items of miscellaneous equipment. Therefore, it appears that the distribution and use of the trucks will be on an entirely different basis from the distribution and use of the other equipment.



DUMP BODY AND HORIZONTAL HYDRAULIC HOIST INSTALLED BY WISCONSIN.

The first definite information received by the States on which they could begin to plan an organization was included in the circular letter sent out by the Bureau of Public Roads on April 19, 1919, in which it was indicated that approximately 20,000 trucks would be available for distribution to the States.

In May the State Highway Department of Texas created a separate division of the department, known as the Federal equipment appropriation division. A man was placed in charge of this division with the title of superintendent, and his duties related solely to the handling of the Federal equipment. Necessary clerical force was at once employed and as the distribution progressed field inspectors, mechanics, and laborers were employed.

#### PLAN OF DISTRIBUTION AND USE.

The first task confronting the Federal equipment appropriation division was to work out a plan of distribution of this equipment to the counties and to formulate regulations in regard to its use. It was decided that the equipment should be distributed to the various counties on a lease basis, and that the counties should be required to execute a legal lease agreement, acknowledging accountability for the property received by them, and stipulating the conditions under which this equipment is to be used.

It was also decided that the counties must bear the full expense of receiving and distributing the equipment, since they are the ones benefited by this appropriation. To protect its interest the highway department considered it necessary to provide for a regular inspection of the equipment after it was placed in the

hands of the counties, therefore, the counties, besides paying reimbursement of receiving charges, were also required to pay an annual rental to cover the cost to the highway department of administering the control and inspection. It has been estimated that a rental of \$2 per month on trucks will be sufficient to cover this cost and this is the rental which the counties are required to pay up until the end of the first fiscal year. At the end of that time this rental may be increased or decreased as found necessary and desirable.

On the basis of the States receiving 20,000 trucks Texas might expect 6 per cent, or 1,200 trucks. Assuming that

some of these would turn up unserviceable, that others would be needed in handling the Federal equipment, and still further reserving a surplus for unexpected contingencies, it seemed safe to take 1,000 as the number which the counties might safely expect to receive. Using this as a total number, a table of distribution percentages was worked out for each of the 253 counties in Texas. The basis of this distribution is similar to that used by the Bureau of Public Roads in apportioning aid among the States.

The various counties of the State were offered officially the number of trucks to which they were entitled under this table. In replying to this offer, the counties were asked to submit their requests in the form of answers to a questionnaire, which gave definite information as to the number of trucks the county would accept, whether less than or in excess of their allotment, information as to mileage of roads in their counties, expended and contemplated bond issues, amount of the annual road and bridge fund, data in regard to the organization for road work, and other pertinent information. As other States have probably found, in dealing with county authorities it is exceedingly difficult to get information from all counties on any subject whatever. The State highway department of Texas used this opportunity, where it was giving something to the counties as the best means of getting a large amount of miscellaneous information long desired and which we had been unable to obtain from all counties. The plan has been almost uniformly successful and there are only a very few of the counties which have not fully and gladly replied to our questionnaire.

### THE LEASE AGREEMENT.

Regulations governing the use of the trucks are embodied in the lease agreement. The important points of this are as follows:

1. The truck is identified by State registration number, motor number, and serial number, and by make and capacity.

2. Every item of equipment furnished on the truck is listed in the lease agreement and the county assumes full accountability for this equipment. This provision protects the State in case it is later found necessary to recall the truck from the use of the county.

3. The county agrees to keep the truck in a proper state of repair and good working order, due allowance being made for natural depreciation with use.

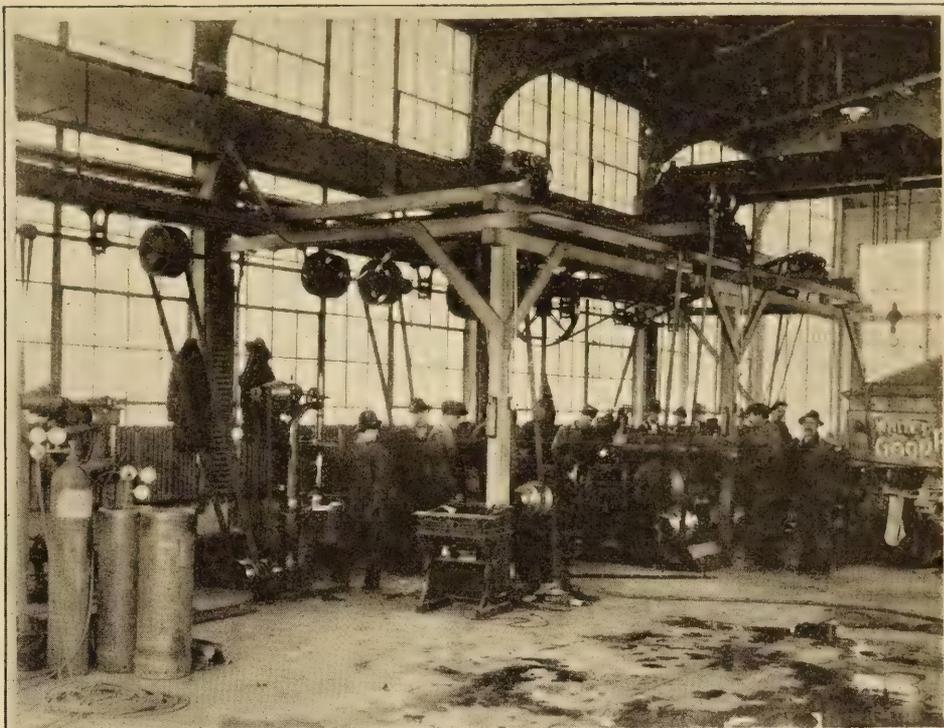
4. The truck is to be used on highway work only and on the public roads under the jurisdiction of the county commissioners' court.

5. The State highway department is to have free access to the truck at all times for the purpose of inspection, to insure that the provisions of the lease agreement are being carried out.

6. The county agrees to provide covered storage for the truck when not in use, to keep it covered with a waterproof tarpaulin, and further agrees to paint the truck once a year.

7. The county accepts full liability for the expense of receiving such equipment as is delivered to it. The county makes a payment of \$150 at the time of executing the lease agreement and agrees to pay such further sum as may be later assessed. Also, at the time of executing the lease agreement the county makes a rental payment at the rate of \$2 per month for the time remaining until the end of the fiscal year.

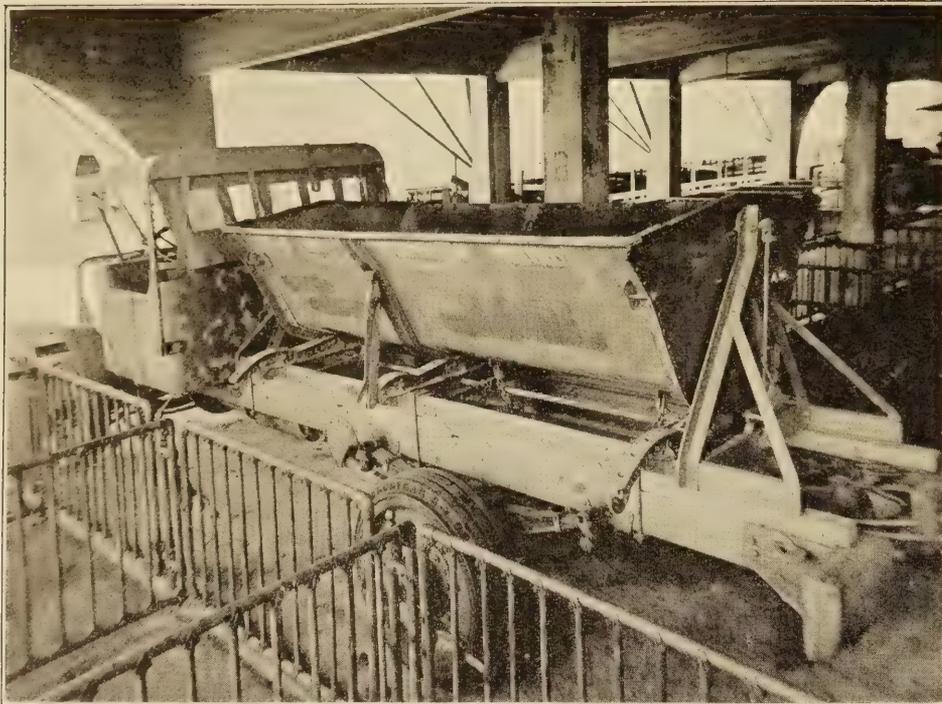
8. Provision is made for recall of the truck from the county by the State highway department upon giving two months' notice of such intent to recall and upon reimbursement to the county by the State highway department of all unearned rental and a certain per cent of the receiving charges which may have been paid by the county. The per cent of receiving charges to be refunded ranges from 100 per cent when the truck is recalled at any time up to 3 months after delivery of the truck down to 50 per cent when recalled after 27 months after delivery of truck.



INTERIOR OF SHOPS, UTAH. ABOVE, MACHINE SHOP. BELOW, FORGE SHOP.

### DISTRIBUTION OF CHARGES.

In arriving at a fair distribution of receiving charges, there are several considerations involved. In the first place, counties adjacent to Camp Normoyle receive their trucks by direct convoy, and the charge entailed in receiving these trucks from the Army, making necessary repairs, and delivering to the counties may not exceed \$40 to \$50 per truck. On the other hand, there



ONE OF THE BODY TYPES INSTALLED BY NEBRASKA.

are some counties in the extreme western part of the State which receive trucks that were shipped by freight from points in the northeastern part of the United States, and in some cases freight alone has amounted to over \$300 per truck. Another consideration involved is that on an average it will cost the State highway department just as much to receive an old worn-out 2-ton truck of an inexpensive make as it will to receive a brand new 3-ton truck of a more expensive make which may actually be valued at twice to three times the value of the cheaper, lighter truck. Manifestly, then, it would be unfair to require a county to pay the exact charges which are incurred in receiving the trucks it gets, and a more equitable arrangement would be to have each county pay the same for the same kind and type of truck in similar condition of repair. Accordingly, we will take the total receiving charges on all trucks and then assign such charge against the different makes and types of trucks as will reimburse the highway department for the full amount paid out, and every county will pay the same for the same make and type of truck. Of course, a scale of charges will be established whereby the receiving charges on the most valuable trucks will be more than the receiving charges on the least valuable.

While the details which have been enumerated were being worked out in the main office of the State highway department, the work in the field was also being put under way. A rough estimate was made of the number of trucks which will be needed in the different sections of the State and some dozen distribution points were selected as stations from which trucks

could be delivered. The points were so selected that the longest drive from any distribution station to a county seat is not more than 200 miles, and the majority of county seats fall within a 100-mile radius. These stations were selected and inspectors were sent out in the field to make preliminary investigations, and when a certain town was decided upon as being suitable for our purpose the inspector made all preliminary arrangements for storage, purchase of supplies, and employment of labor. Factors affecting the selection of distribution stations were available storage space, garage and shop facilities, availability of labor, railway facilities, and highway connections to neighboring counties.

#### DETAILS OF DISTRIBUTION.

The State highway department at Austin receives a notice by wire that a certain number of trucks are available for immediate shipment. We then wire the Bureau of Public Roads complete shipping instructions on this shipment, which shipping instructions are transmitted through the Chief of Motor Transport Corps to the Army supply depot where trucks are stored.

The Army supply depot then ships the trucks to the distribution station ordered, bills of lading and bills for loading are sent direct to the office of the State highway department at Austin; an inspector is immediately dispatched to the distribution station, and by the time trucks arrive he is there ready to unload them. As soon as the trucks are received they are checked over and a complete list of all equipment is then sent in to the office. This is the official notice that the trucks have been received by the State of Texas, and accountability for this equipment begins at this point.

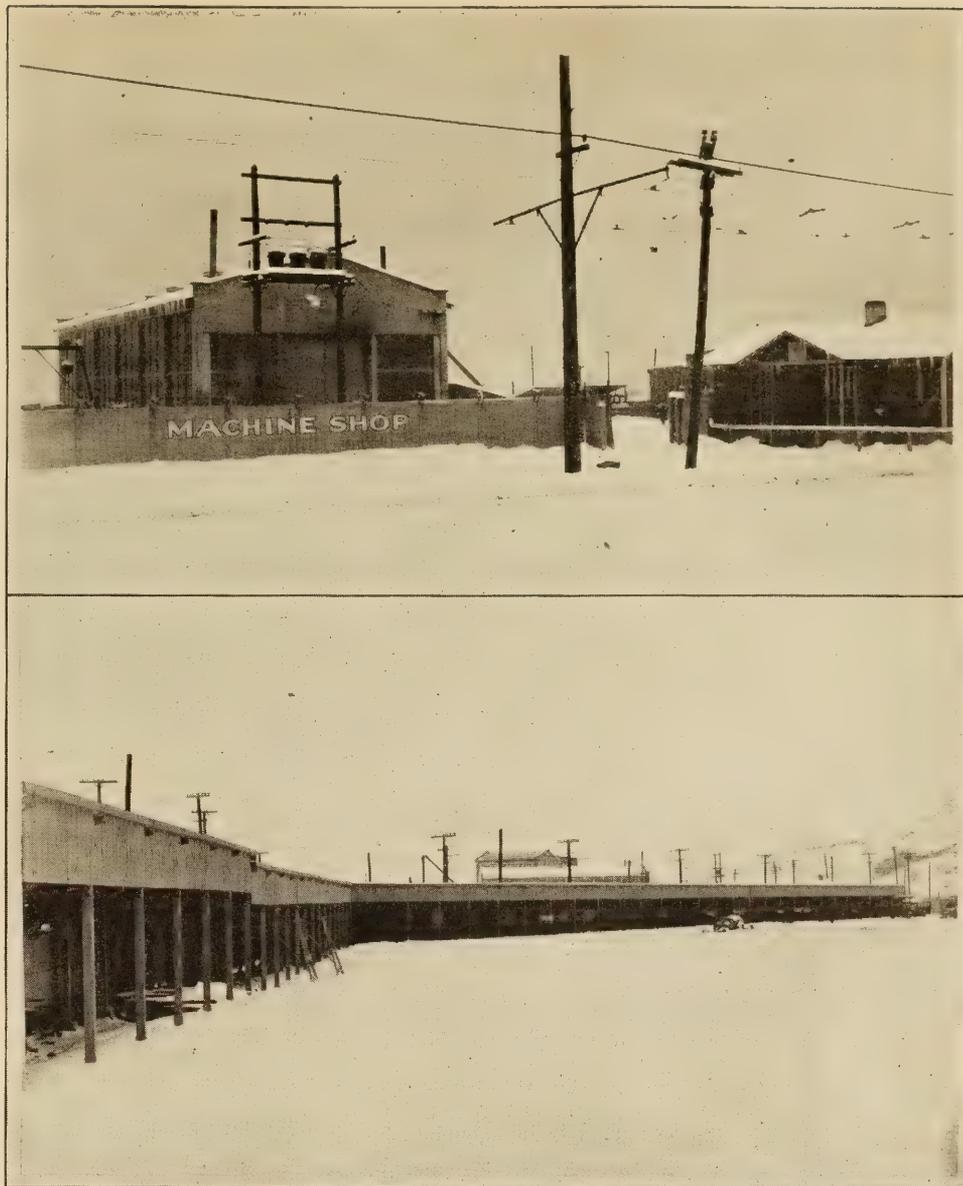
As soon as notified of receiving the equipment the highway department acknowledges receipt to the Bureau of Public Roads, to the Chief of Motor Transport Corps, and to the shipper. Bills for loading and freight bills are then approved and paid. The inspector has now employed a first-class mechanic and a sufficient number of drivers and laborers. The trucks are unloaded, under their own power, and are driven or towed to the garage or storage space at the distribution station. Here they are gone over thoroughly, are greased, oiled, have their motors tuned up, and are tried out to see that they are in first-class condition;

all necessary repairs are made; and when trucks have been tried out and are found in first-class shape they are then ready for distribution to the counties.

Several days before this the Austin office is notified by the inspector that the trucks will be ready for delivery on a certain date. Authorizations are made out in the office in quadruplicate copy. The original and duplicate are sent to the county judge with instructions to have a representative call for the trucks allotted the county on these authorizations on a certain date at the distribution station, the representative to bring these copies of the authorization with him. The triplicate copy is sent direct to the inspector as a notice to him that such and such a truck is to be delivered to a county with certain specific items of equipment on hand on a certain date. The fourth copy of this authorization is retained in the office files.

The county judge next sends his representative to the station on the date mentioned, the truck is filled with gas, oil, water, and in good running condition is turned over to the representative of the county. The equipment is checked over by both the State highway department inspector and the county's representative, and both men sign both the original and duplicate copies of the authorization, thereby acknowledging delivery and receipt of the equipment which is then transferred to the county. The county representative keeps the duplicate copy of the authorization and the original copy is sent to the Austin office immediately. The county representative takes the trucks and drives them back to his own county.

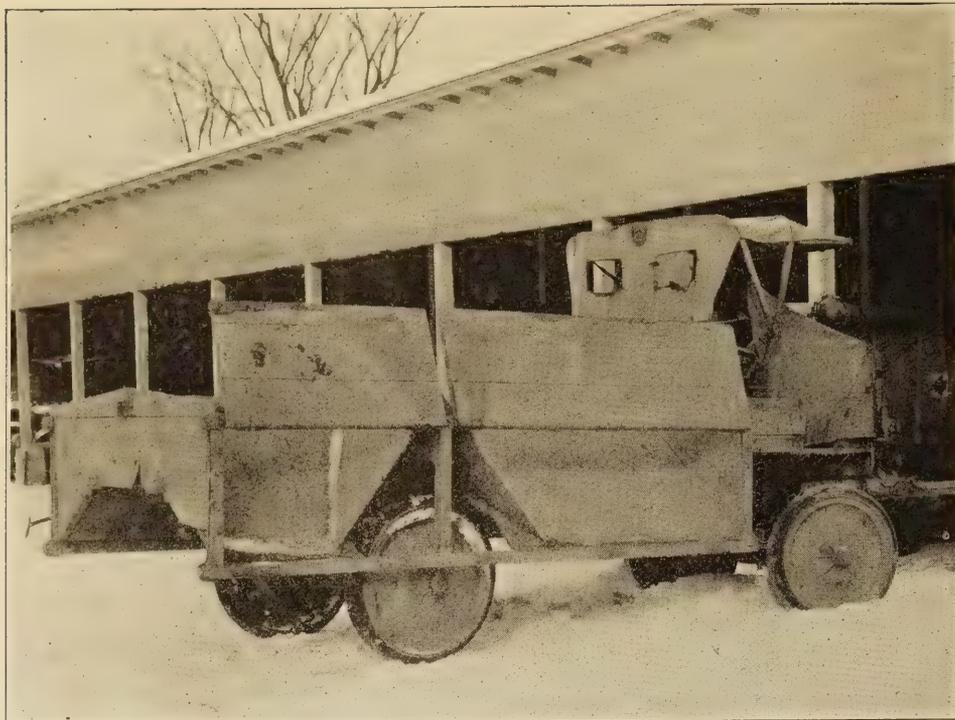
The next step is the execution of the lease agreement. This is made up in duplicate copy in the office of the State highway department. It is then sent out to the county judge with a statement of preliminary charges against this equipment. The county judge executes the lease agreement by having it signed by the four members of the commissioners'



ABOVE, EXTERIOR VIEW OF UTAH'S MACHINE SHOP. BELOW, INTERIOR OF STOCKADE AND STORAGE SHEDS, UTAH.

court, and himself, and he returns both copies of the agreement to the department at Austin accompanied by a check covering the charges for which he has been billed.

The agreement on reaching Austin is signed by the State highway engineer on behalf of the State highway department. The original is kept in the office files and the duplicate is returned to the county judge. There is an extra step involved here in sending the agreement out originally unsigned and then having it returned to Austin for the signature of the State highway engineer, but this is absolutely necessary to insure this being properly done, for were the agreement made up, signed by the State highway engineer, and then sent out for the signature of the county officials, there would be numerous cases where these agreements would never be returned.



SIDE DUMPING BODY ADOPTED BY VERMONT.

At a later date when the complete charges against this equipment become known the county will be billed for the balance due on the trucks they have received. The transaction is then complete; the equipment is the property of the State highway department and is being operated by the county on a lease basis.

#### EQUIPPING WITH DUMP BODIES.

The experience of Texas in equipping the trucks with dump bodies is probably not that of the majority of the States, and our case, therefore, may not be of general interest. The deciding factor is a geographical one. Due to the vast extent of the State in area, it was necessary to receive and distribute trucks at more different points than in perhaps any other State. To have received these trucks all at one point and there equipped them with dump bodies and then have them again shipped out to the counties would have involved a delay and expense which hardly seemed justifiable. Likewise it was not possible to have all the trucks which were going to any one distribution station shipped to that station at one time as these trucks were urgently needed over the whole State, and had the department adopted the policy of supplying one section of the State completely at first and then proceeding to another section the neglected counties would have certainly offered very vigorous and well-justified objection. Another factor in this matter was that where a county has several trucks allotted to it, it would in all probability desire one truck as a general maintenance truck and would prefer to have the original box body with which most of these trucks are equipped. Also, as the counties

were to be asked to bear the full expense of receiving these trucks, it was nothing but right that the decision as to type of dump bodies which they desired to operate and pay for should be left in their hands. Accordingly, this matter has been left entirely up to the individual counties, and they are making such selection of body equipment as they deem best suited to their needs and financial resources.

There is one phase of this matter in which the State highway department has taken the initiative. We have experimented with cutting down the steel ammunition body with which our Nash quad trucks were equipped. We have found that this can be made into a practical dump body by removing the steel

body from the chassis, cutting it down with a blow torch to a depth of 15 inches, riveting a small angle-iron around the cut edge, and equipping the body with a swinging tail gate at the back end and mounting it back on the chassis with a hand hoist attached between the body and the cab. Business firms in Texas do this work and are able to supply us at a price which affords a saving of from \$100 up over any other steel dump body which we have thus far been able to obtain.

#### OTHER EQUIPMENT.

One of the distribution stations for trucks is located at Austin, the headquarters of the highway department. This station has been expanded and is being used to receive all other equipment allotted us besides the trucks, and a permanent central organization is maintained there. The stock of spare parts which the department has received for the Nash trucks has already been shipped into this point and has been stored, inventoried, and catalogued, and a clerk is in charge of this stock and is occupied in filling orders which come in for spare parts and accessories from the various counties.

Deliveries to Texas of this miscellaneous equipment have been far behind truck deliveries, and whereas we have received about 35 per cent of our trucks to date we have only received a small fraction of the total miscellaneous equipment which has been allotted. In view of the uncertainty as to how much of this equipment will eventually be delivered, it is considered best to receive and store it at the Austin station until

definite assurance is available as to exactly what quantity of each item of equipment will be received, and it is not planned to put any of this equipment in the hands of the counties until such information is at hand. As the equipment is received, it is in serviceable condition and stored, and it is not contemplated that very much of this will be delivered to the counties before next spring, when we hope that practically all that we were going to get will be in our hands.

Special regulations will be drawn up covering the use of this special equipment, but the plan will be similar to the plan under which the trucks are being used. That is, the equipment will be leased to the counties, and when the need of a particular county has ceased the equipment may be withdrawn and allotted to some other county. Accurate account is kept of the receiving charges on every different item of equipment, and counties will be required to reimburse the State highway department for all expense incurred in handling the equipment which the counties receive.

#### RENTALS AND INSPECTION.

In the matter of rentals to contractors and force account jobs, the State highway department of Texas approves three different schemes on which this may be carried.

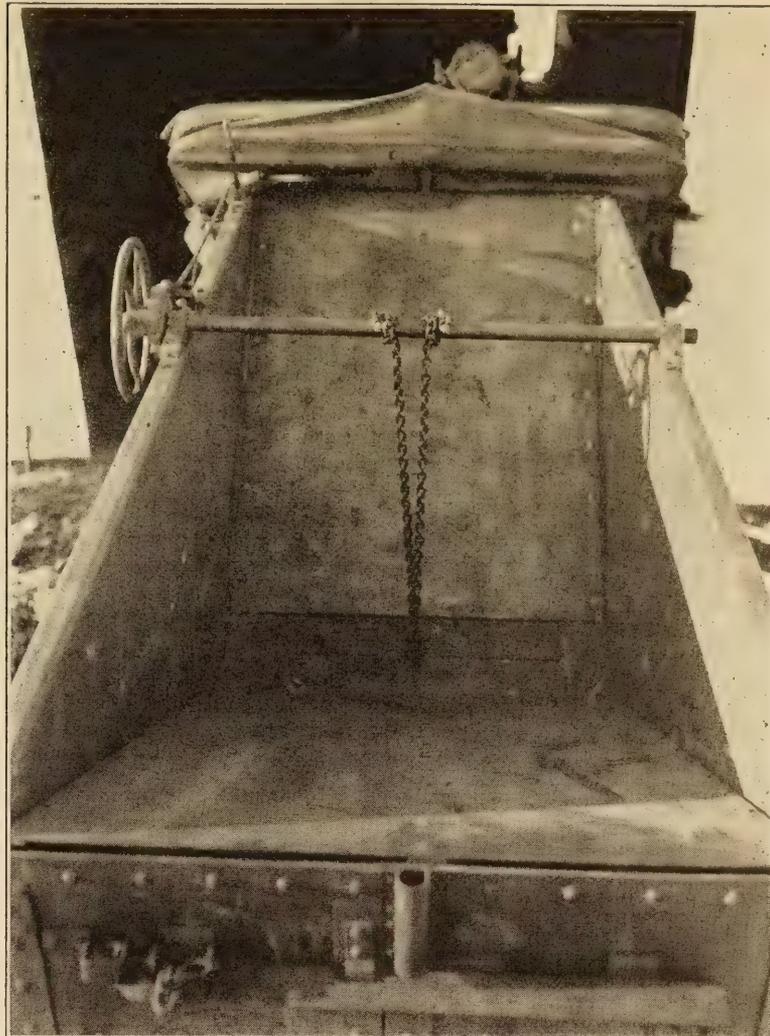
1. Where the equipment is available in the county at the time the contract is to be let, the county may advertise for bids on the basis of furnishing the contractor with certain specific equipment.

2. The county may lease the equipment to the contractor for a certain specified cash price, but such contracts must be submitted to the State highway department for approval.

3. The county, as a private party, may haul for the contractor on a ton-mile basis at the usual pay for such work, the county using its own trucks and drivers.

In this matter of rentals to contractors and force account jobs, every individual case must necessarily be examined on its own merits, and the division engineers of the highway department, who are in close touch with all the counties, make recommendation as to what action the department should take in each case.

The State highway department intends to exercise its control over this equipment by maintaining frequent inspections. The State is divided into eight districts, with a division engineer as the official representative of the State highway department in each district. Divisional inspectors have been put on in these districts



INTERIOR VIEW OF IDAHO HOPPER BODY.

and these men work under orders from the division engineer. Their duties involve the inspection of this Federal equipment, submitting necessary reports in regard to the use and possible misuse of it and other matters pertaining to traffic regulations and registration of the motor vehicles. The division engineer in his visits to counties also transacts some of this business, and in this way the highway department is enabled to maintain a close supervision of the use of this equipment.

The benefits to be derived by the State from the equipment that has been received and will be received from this source can not be accurately calculated. We feel that the maximum amount of good will accrue under the plan that has been adopted for its use in Texas. In our opinion, Congress did an exceedingly wise thing when it decided to distribute this equipment in this way, rather than selling it at a tremendous sacrifice to private individuals and corporations.

## WEST VIRGINIA'S GOVERNOR FOR GOOD ROADS BONDS.

West Virginia next fall will vote on a constitutional amendment that will make possible the bonding of the State to the extent of \$50,000,000 for the building of good roads. This is Gov. Cornwell's proposition. He wants his State to have as complete a system of articulated roads as any other. That's why he sets an example whenever he can to show his people the value of good roads.

"If we had in this country a system of good roads covering every State, railroad strikes would have no terrors for us," said the governor. "We would not then be dependent upon the whims of a few men. And it is coming. Eventually we shall have highways over which we can haul to markets all of our farm products. The development of motor trucks for heavy hauling is a matter of only a short time, and I am confident that within a decade we shall have a highway system that will make us virtually independent of the railroads in emergencies. Today, however, a railroad strike is a very serious matter. In West Virginia, for instance, there were sections which in a week or 10 days would have been entirely out of food supplies if the recent unauthorized railroad strike had continued. Good roads serving every community, large or small, would make such a situation impossible."

### PAVEMENTS ON THE LINCOLN HIGHWAY.

Of the 3,223 miles of the Lincoln Highway between New York City and San Francisco, there are 801 miles classed as graded dirt, 749 miles classed as graded gravel, 244.5 miles classed as natural dirt, 207.2 miles classed as natural gravel, 17 miles classed as shale, and 13.2 miles classed as sand. The remainder of the route is paved or macadamized, the different types of surfacing and the milages being as follows: Bituminous macadam, 406.3; concrete, 317; brick, 197.8; macadam, 175; asphalt, 80.6; granite block, 7.8; and creosoted wood block, 6.6. These figures are for March 1, 1920, and were furnished by the Lincoln Highway Association.

In the foregoing classification, as well as in that arranged by States, the following explanation, supplied by Vice President Bement, of the association, should be noted:

In order to simplify the table, we have classified all forms of concrete construction under one head, "concrete." This, therefore, includes one and two course concrete construction, and whether reinforced or not or bituminously treated or not.

"Asphalt" refers only to sheet asphalt and in the table is practically all represented by city street paving traversed by the Lincoln Highway through

the many municipalities. Much of the total brick mileage is also brick streets in cities.

"Macadam" refers to all forms of macadam with the exception of bitulithic or bituminous macadam. Any macadam treated with anything besides water is included under "bituminous macadam."

The mileages of the different types, by States, are as follows:

*New Jersey.*—Asphalt, 28.5; concrete, 21.2; granite block, 7.8; creosoted block, 3.6; brick, 1.9; total, 63.

*Pennsylvania.*—Bituminous macadam, 266.3; brick, 40.3; asphalt, 28; concrete, 19.7; graded dirt, 14; creosoted block, 3; total, 371.3.

*Ohio.*—Brick, 85.3; macadam, 73.5; bituminous macadam, 54; graded dirt, 19.9; concrete, 8.9; total, 241.8.

*Indiana.*—Concrete, 54.4; graded gravel, 45; macadam, 31; brick, 28; asphalt, 6; total, 164.4.

*Illinois.*—Concrete, 75.8; graded gravel, 32.2; brick, 18.4; graded dirt, 17.2; macadam, 13.5; asphalt, 5.3; total, 162.4.

*Iowa.*—Graded dirt, 260.1; graded gravel, 106.5; brick, 15.2; concrete, 4.9; asphalt, 4.1; total, 390.8.

*Nebraska.*—Graded dirt, 313.2; graded gravel, 108.4; concrete, 9.6; light sand, 9.2; brick, 8.5; natural gravel, 8; bituminous macadam, 7.1; asphalt, 2.9; total, 466.9.

*Wyoming.*—Graded gravel, 193.1; graded dirt, 114.6; natural dirt, 92.5; natural gravel, 31; shale 15; concrete, 0.3; total, 466.5.

*Utah.*—Graded gravel, 54.8; natural dirt, 51; macadam, 40.2; natural gravel, 26; graded dirt, 24; bituminous macadam, 9.5; concrete, 7.9; sand, 4; asphalt, 2; total, 221.4.

*Nevada.*—Graded gravel, 182.7; natural gravel, 133.9; natural dirt, 101; graded dirt, 22; macadam, 12.5; concrete, 6; asphalt, 0.8; total, 458.9.

*California.*—Concrete, 108.3; bituminous macadam, 69.4; graded gravel, 26.3; graded dirt, 16; natural gravel, 8.3; macadam, 4.3; asphalt, 3; total, 235.6.

### COUNTY ROAD BUILDING PROGRAM.

Adams County, Wash., will undertake the construction of 92 miles of road this year, estimated to cost \$750,000. There are 77 miles of the "Donohue" roads, built under the Donohue law, to cost approximately \$700,000, and 15 or more miles of county roads to be constructed by county force account, to cost \$50,000 to \$60,000. In addition \$80,000 is to be used on road district roads. The county now has 29.5 miles of Donohue roads and 197.75 miles of permanent highways under contract which are to be completed this year. This will cost about \$475,000.

# DISTRIBUTION OF SURPLUS WAR MATERIALS FOR ROAD BUILDING.

By H. L. BOWLBY, Chief War Materials Division, United States Bureau of Public Roads.

THE distribution of road-building machinery, equipment, and supplies from surplus war materials to the State highway departments was made possible by an act of Congress approved February 28, 1919. This was section 7 of the Post Office appropriation act, and read as follows:

That the Secretary of War be, and he is hereby, authorized, in his discretion, to transfer to the Secretary of Agriculture all available war materials, equipment, and supplies not needed for the purpose of the War Department but suitable for use in the improvement of highways.

It will be noted that the provisions of this act are very broad and provide the necessary authority for the transfer of any material in the possession of the War Department that is surplus and suitable for use in the improvement of highways. A letter from the Secretary of War, dated May 3, 1919, made available the first list of materials and equipment for distribution to the States, and the Director of the Division of Purchase, Storage, and Traffic was directed to turn this material over to representatives of the Secretary of Agriculture on his order.

This list was very general in its scope, covering engineering equipment, small construction tools, steam shovels, locomotive cranes, and miscellaneous road-building machinery.

The second extensive list of surplus road-building equipment was transmitted to the Bureau of Public Roads by the director of sales of the War Department in a letter dated May 24, 1919. The list was a very extensive one, covering 14 closely typewritten pages. Among the items cleared at this time were the 15 and 20 ton Holt caterpillar tractors, a quantity of office supplies and equipment, engineers' transits and levels, and miscellaneous road-building tools and machinery.

The requirements of the State highway departments were obtained by means of mimeographed copies of the list of road-building machinery, tools,



DUMP BODY WITH HAND HOIST INSTALLED BY THE MARYLAND STATE ROADS COMMISSION.

and supplies furnished the bureau by the Division of Sales of the War Department. From the replies received the final distributions were made and definite shipping instructions prepared and forwarded to the division of sales.

An attempt has been made to treat all States impartially in the distribution of the material available. The shipments made by the War Department in accordance with our shipping instructions have been made in an impartial manner. The unfortunate feature has been that, due to various causes, all of the material originally cleared as being available for distribution has not been shipped. This has resulted in some of the States receiving certain classes of material and machinery which other States have not received. A rough estimate at this time indicates that approximately 10 per cent of the quantities of road-building machinery, equipment, and supplies made available at various times by the War Department have been distributed to the State highway departments. This is exclusive of motor-propelled vehicles and spare parts.

Under date of June 9, 1919, the Secretary of War notified the Secretary of Agriculture that the War Department would deliver out of the surplus in the United States or in France the equipment and supplies in the list submitted by the latter.

LIST ASKED FOR BY PUBLIC ROADS.

The list of road-building machinery and equipment requested at that time was as follows:

- 524 5-ton caterpillar tractors.
- 1,035 10-ton caterpillar tractors.
- 742 Engineers' transits.
- 797 Engineers' levels.
- 800 Abney hand levels.
- 2,500 Steel tapes.
- 1,200 Level rods.
- 500 Planimeters.
- 300 Drafting tables.
- 400 Road rollers, steam and gas driven.
- 700 Concrete mixers.
- 600 Road graders.
- 400 Elevating graders.
- 200 Sprinkler wagons.
- 200 Road oilers, motor-driven.
- 125 Derricks, 30 to 60 feet.
- 100 Pile drivers, complete outfits.
- 200 Air drills, complete sets.
- 250 Steam pumps, 3 and 4 inches.
- 150 Centrifugal pumps, with power to 4 inches.
- 75 Diaphragm pumps, gasoline-driven.
- 500 Rock crushers, complete outfits, 125 to 200 tons capacity.
- 200 Buckets, clamshell, orange-peel, and bottom-dump.
- 125 Road scarifiers.
- 50 Excavators, caterpillars and drag-line.
- 700 Plows, road and railroad.
- 300 Plows, rooter.
- 25 Automotive cranes.
- 3,600 Trailers for tractors.
- 500 Miles industrial railway track.
- 200 Industrial railway locomotives.
- 3,500 Industrial railway dump cars.
- 200 Steam shovels, 1-yard and less capacity.

- 6,500 Dump wagons.
- 250 Conveyers, gravity and power.

Engines.

- 35 Donkey
- 200 Hoisting } from 5 to 30 horsepower.
- 75 Gasoline
- 375 Steam drills, complete outfits.
- 250 Portable air compressors.
- 100 Boilers, 15 to 30 horsepower.
- 275 Electric motors, 2 to 30 horsepower.
- 20 Electric blue-print machines.

A representative of the Department of Agriculture was sent to France the first part of July, 1919, to assist the War Department in the selection of machinery and equipment suitable for road building to be returned to the United States in conformity with this list

EQUIPMENT RETURNED FROM FRANCE.

The following is a tabulation showing the road-building equipment which was returned from France in response to a cable from the Secretary of War, dated June 20, 1919, to the liquidation commission of the War Department in France, for delivery to the Department of Agriculture:

	Lake Gleat.	Lake Franconia.	Saint Naiwa.	Lake Sapor.	Peetless.	West Loquassuok.	Nyanza.	Santa Cecilia.	Cape Romain.	Chiacau.	West Gotomska.	West Kuechee.	Waxabachie.	Hoxie.	Woonsocket.	Fort Stevens.	Python.	Lambs.	West Islay.	Western Scout.	Arizonan.	Total.
Boilers, 20 horsepower									6													6
Boilers, 25 horsepower									1													1
Boilers, hoisting engine																		10				10
Buckets, clamshell		169	4			1																177
Buckets, orange-peel		69	8			4																89
Cabs, locomotive																						36
Cab tops			36									17										17
Cars, 36-inch gauge																						9
Cars, 36-inch gauge, spare parts						9																9
Cars, parts									11													11
Compressors, air											1	1										2
Engines, hoisting											1		16									16
Excavators											1											1
Fuel-oil system									1													1
Graders, Austin elevating			8																			8
Graders, road						13					1	2					8	8				32
Hoists, gasoline									2													2
Hoists, steam									12													12
Headlights													3									3
Locomotives, 36-inch gauge																						26
Locomotive equipment, 36-inch gauge		165											9									165
Mixers, concrete																						59
Motors, electric		249							2			2			25	16						53
Pumps, centrifugal			9	1					10													20
Pumps, steam				3					11													14
Plants, asphalt-mixing																						11
Plows, railroad																	27					27
Plows, road											5	6										11
Plows, rooter											2											2
Plows, spare parts											1											1
Pumps																54						54
Railroad equipment, 27 pieces:																						
Derrick parts																						63
Drivers, flat-wheel																						2
Drivers, flange																						18
Rim, flat-wheel																						1
Tubes, boiler																						6
Rollers, road																						8
Tenders, locomotive														2	17							19
Tenders, 36-inch gauge locomotive																						4
Tenders, 36-inch gauge locomotive, spare parts			3																			9
Tractors, 2 1/2-ton						5																5
Tractors, 5-ton							107	2														123
Tractors, 5-ton Reo			29							16												145
Tractors, 10-ton						71	21															138
Tractors, 10-ton Holt				3						1												14
Trucks, 36-inch gauge		44																				44
Trucks, 36-inch gauge tender			4										4									8
Tractors																	18					118
Tractors, Cleveland																						2
Trees																						11
Underframes, 36-inch gauge									6								11		2			6
Wagons, dump		52	76								41	41										242
Wagons, Watson dump				21																		21
Wagons, dump—parts																						379
Wagons, dump—poles for						379																18
Wheels																	18					70
Yokes, neck																	4					4

<sup>1</sup> Refused to release.

<sup>2</sup> With pumps.

## TRANSFERRED TO APRIL 1, 1920.

The following statement shows all of the miscellaneous war materials, supplies, and equipment that have been transferred from the War Department for road-building purposes up to April 1, 1920:

Axles, dump-wagon	9	Kettles, tar	5
Bollers:		Lanterns, railroad combination	6,937
Various horsepower	9	Level:	
20-horsepower	7	15-inch engineers'	4
25-horsepower	5	Engineers'	180
Thew	1	Builders' wye	1
Loeffel 30-horsepower	1	Hand	1
Boxes, engineers' transit	2	Wye	21
Bridges, steel highway	1	Locomotives, 36-inch gauge	20
Brooms, stable	5,653	Machine:	
Buckets:		Parson, back-filling	1
Clamshell	150	Trenching, Parson, 36-inch	1
Orange-peel	113	Mattocks	2,100
Concrete-mixer	4	Mauls:	
Buggies, Lakewood:		Spike No. 10	2
6 cubic feet	96	No. 12	22
8 cubic feet	38	No. 16	5
Cameras, 3½ by 5½	60	Mill-crushing, Allis-Chalmers, 2-roll	1
Carpenters' shops, portable	10	Mixers, concrete:	
Cars:		Miscellaneous	90
Dump, 4-yard	4	Foote, No. 40	3
Western side-dump, 24-inch gauge	2	Milwaukee, ¼-yard	1
Standard steel cradle	6	Steam-driven	2
Car:		Smith	3
36-inch gauge bodies and parts	23	Ransome, 1 cubic yard	11
Koppel, 3 cubic yards	12	Ransome, ½ cubic yard	1
Trucks, 36-inch gauge	34	Koehring, 30 cubic foot	1
Underframes, 36-inch gauge	111	Lakewood, ¼ cubic yard, steam	1
Carts:		Motors, electric:	
Lumber, 36-inch gauge	12	1½-horsepower	1
Concrete, push, ½-yard	79	2-horsepower	2
Concrete, lmsley	10	3-horsepower	7
2-wheeled dump, 1-horse	10	4-horsepower	1
2-wheel, water, 150-gallon	36	5-horsepower	29
Chains, surveyors':		7½-horsepower	3
300-foot	1	10-horsepower	6
100-foot	1	12-horsepower	1
Chains:		13.6-horsepower	5
Stanley hook skid	777	15-horsepower	11
Antiskid	sets 7,800	16.5-horsepower	1
Compasses, box	200	20-horsepower	4
Compressor:		32-horsepower	3
Gardiner Rex	1	40-horsepower	3
Portable air	3	41-horsepower	2
Conveyor, power	1	50-horsepower	7
Crane:		55-horsepower	1
Byer's auto with clamshell bucket	4	75-horsepower	2
Traveling, 10-ton	1	85-horsepower	9
Crowbars	150	D. C., 1,100 to 1,600 r. p. m.	1
Crusher, stone, single-roll, Jeffery Manufacturing Co.	1	125-horsepower	1
Derricks, various	35	Motorcycle, Cleveland	158
Derrick, 2-ton, stiff-leg	1	Parts, spare:	
Derricks, 5-ton	19	Buick	lots 5
Detonators, Nos. 6 and 8	3,653,350	A. P. buckets	sets 6
Drills, air:		Car, 36-inch gauge	cases 513
Little David	1	Diamond T	lot 1
No. 4	4	F. W. D. brackets for tops	598
Dynamite, 60 per cent, low-freezing	4,000	F. W. D tops with curtains	598
Engines, gas, miscellaneous	2	Ford	lots 4
Engines:		G. M. C.	do 4
Hoisting Mundy	1	Heavy aviation, 3-ton	lot 1
Gas, 3-horsepower pump, 4 by 5 inches	6	Hudson Super Six	do 1
Engine:		International 2-ton	do 1
10-horsepower Novo-gas	1	Locomotive, 36-inch gauge	cases 41
Hoisting	47	Kelly-Springfield	lot 1
Excavator	1	Moreland	do 1
Exploders	68,940	Nash 2-ton	lots 49
Forges:		Nash, tops and curtains	sets 408
Blacksmith	1	Overland	lots 2
Portable	1,836	Packard	lot 1
Forks, stone	37	Pierce Arrow	lots 10
Frames, saw, portable	20	Selden	lot 1
Generator, Delco, 3-kilowatt	10	Holt tractor, 75-horsepower	lots 2
Graders:		Trailer, 15-ton	cases 25
4-wheel	16	Velie	lot 1
Elevating, Austin	29	Whites, 5 and 3 ton	lots 2
Handbook:		Wilson	lot 1
Heavy aviation	167	Picks	1,768
F. W. D.	30	Pipe:	
Nash quad	195	Iron water	feet 4,013
Handle:		Cast-iron—	
Ax	6	12-inch, 4-foot length	do 500
Mattocks	50	18-inch	do 2,000
Sledge, 30-inch	12	24-inch	do 422
Harrow, disk	1	36-inch	do 363
Hatchets	650	Planimeters	131
Hoes:		Plants, asphalt	11
Grub	316	Plows:	
Mortar	69	Road	106
Hoist:		Tractor, 14-inch	8
Chain, 2 and 3 ton	14	Poles, range	3
3-drum and boiler	4	Posts, fence	77,900
9 by 10 inches	7	Powder, black blasting No. 3F	pounds 1,450,000
Gas	1	Pumps:	
Steam	8	Barnes Novo, 6-horsepower	30
Electric, 35-horsepower	1	Blackmer, rotary	33
7 by 10 inch, double-drum lift, boiler	12	Centrifugal, miscellaneous	53
Steam, boiler, and swinging engine	5	4 by 5 inch cylinder Novo engine	1
Hopper:		Power, No. 10 and parts	12
2-way gated	2	Centrifugal, boring	1
20-foot Ransome	2	Centrifugal, Salmon	9
Jacks, 25-ton telescopic, screw	68	Hand	1,050
		Steam, Black & Knowles	1
		Steam, Cameron	2
		Steam, Worthington	15
		Steam, C. H. & E.	6
		Steam, miscellaneous	7
		Fairbanks & Morse, 8 by 4 by 10	32
		Mine-sinking, and parts, Keystone	3
		Mine-sinking, model D	8
		Multistage type, Bovin & Co.	1
		Ranges, cook Nos. 1 and 2	694
		Rods, level	34

Rollers:		
Steam.....	1	
Road 5-ton Austin.....	7	
Road 10-ton Austin.....	1	
Scoops, Alty.....	12	
Scrapers:		
Road.....	11	
Sauerman, 1½-yard.....	1	
Slip.....	105	
Club Kibourne.....	21	
Syracuse No. 1.....	12	
4-wheel.....	14	
Shovels, miscellaneous.....	7,684	
Sledges, double, 8-pound.....	12	
Steel:		
Bars, reinforcing, 1½-inch..... pounds.....	420,790	
Tool, hexagonal..... do.....	36,050	
Tables, folding.....	40	
Tampers, concrete.....	6	
Tanks:		
Galvanized-iron, 165-gallon.....	605	
480-gallon.....	100	
Tank, locomotive, 36-inch gauge.....	1	
Tapes:		
Steel, miscellaneous.....	20	
Steel, 100-foot.....	128	
Steel, 50-foot.....	56	
Metal, 25-foot.....	700	
Metal, 50-foot.....	660	
Metal, 100-foot.....	275	
Tar pot on wheels.....	1	
Tender, locomotive, 36-inch gauge and parts.....	14	
Tents:		
Pyramidal, large.....	5,560	
Pyramidal, small.....	150	
Storage.....	107	
Wall.....	124	
Tires, auto.....	165	
T. N. T..... pounds.....	5,600,000	
Tractors:		
Cleveland, 5-ton.....	6	
Miscellaneous, 5-ton.....	16	
Holt, 10-ton.....	6	
Holt, 20-ton.....	299	
Gas-driven, Titan, 15-30 horsepower.....	33	
Gray, wide-drum.....	12	
Holt, 75-horsepower.....	2	
Holt, 15-ton.....	31	
Trailers:		
3-ton platform.....	17	
Searchlight.....	1	
5-ton drop-frame.....	14	
15-ton.....	2	
Transits, engineers'.....	145	
Trees:		
Single.....	16	
Double.....	6	
Trucks and warehouse cargo.....	12	
Wagon:		
Dump, miscellaneous.....	207	
Sprinkler, 450-gallon.....	194	
Wheelbarrows.....	245	

#### THE WADSWORTH-KAHN LAW.

A supplemental act of Congress was approved March 15, 1920. This act, known as Public No. 159—66th Congress, is merely more specific than section 7 of the Post Office appropriation act approved February 28, 1919, and reads as follows:

An act to authorize the Secretary of War to transfer certain surplus motor-propelled vehicles and motor equipment and road-making material to various services and departments of the Government, and for the use of the States.

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,* That the Secretary of War be, and he is hereby, authorized and directed to transfer such motor-propelled vehicles and motor equipment, including spare parts, pertaining to the Military Establishment, as are or may hereafter be found to be surplus and no longer required for military purposes, to (a) the Department of Agriculture, for use in the improvement of highways and roads under the provisions of section 7 of the act approved February 28, 1919, entitled "An act making appropriations for the service of the Post Office Department, for the fiscal year 1920, and for other purposes:" *Provided, however,* That no more motor-propelled vehicles, motor equipment, and other war material, equipment, and supplies, the transfer of which is authorized in this act, shall be transferred to the Depart-

ment of Agriculture for the purposes named in section 7 of said act than said Department of Agriculture shall certify can be efficiently used for such purposes within a reasonable time after such transfer; (b) the Post Office Department for use in the transmission of mails; and (c) the Treasury Department, for the use of the Public Health Service under the provision of section 3 of the act approved March 3, 1919, entitled "An act to authorize the Secretary of the Treasury to provide hospital and sanatorium facilities for discharged sick and disabled soldiers, sailors, and marines."

SEC. 2. That the Secretary of War is hereby authorized and directed to transfer to the Department of Agriculture, under the provisions of section 7 of the act approved February 28, 1919, entitled "An act making appropriations for the service of the Post Office Department for the fiscal year 1920, and for other purposes," for use in the improvement of highways and roads, as therein provided, the following war material, equipment, and supplies pertaining to the Military Establishment as are or may hereafter be found to be surplus and not required for military purposes, to wit, road rollers, graders, and oilers; sprinkling wagons; concrete mixers; derricks; pile-driver outfits complete; air and steam drill outfits; centrifugal and diaphragm pumps with power; rock crushers; clamshell and orange-peel buckets; road scarifiers; caterpillar and drag-line excavators; plows; crane; trailers; rubber and steam hose; asphalt plants; steam shovels; dump wagons; hoisting engines; air-compressor outfits with power; boilers; drag, Fresno, and wheel scrapers; stump pullers; wheelbarrows; screening plants; wagon loaders; blasting machines; hoisting cable; air hose; corrugated-metal culverts; explosives and exploders; engineers' transits, levels, tapes, and similar supplies and equipment; drafting machines; planimeters; fabricated bridge materials; industrial railway equipment; conveyors, gravity and power; donkey engines; corrugated-metal roofing; steel and iron pipe; wagons and similar equipment and similar equipment and supplies such as are used directly for road-building purposes.

SEC. 3. That the Secretary of War is also hereby authorized and directed to transfer to the Department of Agriculture, for the use of the Forest Service, such telephone supplies pertaining to the Military Establishment which have been found to be surplus and no longer required for military purposes and are needed for the present use of the said service.

SEC. 4. That freight charges incurred in the transfer of the property provided for in this act shall not be defrayed by the War Department, and if the War Department shall load any of said property for shipment the expense of said loading shall be reimbursed the War Department by the department to which the property is transferred by an adjustment of the appropriations of the two departments: *Provided, however,* That any State receiving any of said property for use in the improvement of public highways shall, as to the property it receives, pay to the Department of Agriculture the amount of 20 per centum of the estimated value of said property, as fixed by the Secretary of Agriculture or under his direction, against which sum the said State may set off all freight charges paid by it on

the shipment of said property, not to exceed, however, said 20 per centum.

SEC. 5. That the title to said vehicles and equipment shall be and remain vested in the State for use in the improvement of the public highways, and no such vehicles and equipment in serviceable condition shall be sold or the title to the same transferred to any individual, company, or corporation: *Provided*, That any State highway department to which is assigned motor-propelled vehicles and other equipment and supplies, transferred herein to the Department of Agriculture, may, in its discretion, arrange for the use of such vehicles and equipment, for the purpose of constructing or maintaining public highways, with any State agency or municipal corporation at a fair rental, which shall not be less than the cost of maintenance and repair of said vehicles and equipment.

SEC. 6. That the provisions of the act of July 16, 1914 (Thirty-eighth Statutes, page 454), prohibiting the expenditure of appropriations by any of the executive departments or other Government establishments for the maintenance, repair, or operation of motor-propelled or horse-drawn passenger-carrying vehicles in the absence of specific statutory authority, shall not apply to vehicles transferred, or hereafter to be transferred, by the Secretary of War to the Department of Agriculture for the use of the department under the provisions of this act, or under the provisions of section 7 of the act of February 28, 1919, referred to in section 1 hereof: *Provided, however*, That nothing in this act contained shall be held or construed to modify, amend, or repeal the provisions of the last proviso under the item entitled "Contingencies of the Army," as contained in the act entitled "An act making appropriations for the support of the Army for the fiscal year ending June 30, 1920, and for other purposes," approved July 11, 1919, except as to direction for the transfer of those articles enumerated in section 2 hereof.

Approved, March 15, 1920.

#### TRUCKS AND AUTOMOBILES.

Motor-propelled vehicles were made available by the War Department for transfer to the States in several installments. The first allotment of motor trucks totaled 5,333. This consisted of new trucks, and 5,210 had been delivered on April 1. The second allotment was 2,294 trucks. These were all used and nearly all serviceable, and a total of 1,188 of this allotment have been delivered. The third allotment consisted of 3,948 trucks, nearly all of which were new. Of this number 2,336 have been delivered, making a total of 8,734 motor trucks on the first three allotments that had been delivered to the States on April 1, 1920.

Since November 1, 1919, there have been taken over from the War Department 10,407 motor trucks. All of these have been allotted to the States

and the great majority have been actually shipped. The total number of motor trucks transferred from the War Department for road-building purposes is 19,141. This figure will ultimately be decreased by a few rejections that have been made of trucks that have become unserviceable since their inspection by representatives of the Department of Agriculture.

The following is a statement showing the total number of trucks, Fords, and miscellaneous automobiles allotted to the various States and the totals received on April 1, 1920. The last column shows the percentage of total allotments received by each State. There have been but very few miscellaneous touring cars transferred to the State highway departments. It has been found that nearly all of the motor vehicles of this class were in such unserviceable condition that they would not warrant shipment to the State highway departments.

#### ALLOTMENTS AND DELIVERIES.

	Allotments.			Total vehicles allotted.	Total motor vehicles delivered to Apr. 1, 1920.	Percentage delivered.
	Trucks.	Fords.	Autos.			
1. Alabama.....	432	53	11	496	340	69
2. Arizona.....	282	35	6	323	277	86
3. Arkansas.....	343	42	8	393	326	83
4. California.....	622	77	15	714	579	81
5. Colorado.....	358	44	9	411	344	84
6. Connecticut.....	124	15	4	143	125	87
7. Delaware.....	34	4	4	42	42	100
8. Florida.....	236	29	6	271	200	74
9. Georgia.....	553	68	14	635	514	81
10. Idaho.....	251	51	6	288	230	80
11. Illinois.....	898	110	22	1,030	892	87
12. Indiana.....	556	68	14	638	505	79
13. Iowa.....	595	73	15	683	517	76
14. Kansas.....	593	73	15	681	538	79
15. Kentucky.....	400	49	10	459	368	80
16. Louisiana.....	280	34	7	321	287	89
17. Maine.....	196	24	5	225	182	81
18. Maryland.....	181	22	4	207	137	66
19. Massachusetts.....	303	37	7	347	208	60
20. Michigan.....	596	73	15	684	513	79
21. Minnesota.....	584	72	14	670	549	82
22. Mississippi.....	366	45	9	420	307	73
23. Missouri.....	697	86	17	800	614	77
24. Montana.....	413	50	10	473	370	78
25. Nebraska.....	440	54	11	505	387	77
26. Nevada.....	265	33	7	305	240	79
27. New Hampshire.....	83	11	2	96	88	92
28. New Jersey.....	245	30	10	285	273	96
29. New Mexico.....	331	40	8	379	315	83
30. New York.....	1,021	126	25	1,172	843	72
31. North Carolina.....	470	58	12	540	447	83
32. North Dakota.....	319	39	8	366	287	78
33. Ohio.....	761	94	19	874	762	87
34. Oklahoma.....	476	58	12	546	510	93
35. Oregon.....	326	40	8	374	295	79
36. Pennsylvania.....	942	116	23	1,081	776	72
37. Rhode Island.....	48	6	1	55	52	95
38. South Carolina.....	296	36	8	340	281	83
39. South Dakota.....	333	41	9	383	278	73
40. Tennessee.....	462	57	11	530	461	87
41. Texas.....	1,199	148	30	1,377	1,046	76
42. Utah.....	237	29	6	272	225	83
43. Vermont.....	95	12	3	110	85	77
44. Virginia.....	406	50	10	466	399	86
45. Washington.....	298	36	7	341	263	77
46. West Virginia.....	217	27	5	249	196	79
47. Wisconsin.....	521	64	13	598	399	67
48. Wyoming.....	252	31	7	290	232	80
49. Department of Agriculture.....	1,129	287	55	1,471	799	54
Total.....	21,065	2,737	557	24,359	18,933	78



# SUBGRADE INVESTIGATIONS BEGUN BY BUREAU OF PUBLIC ROADS.

THE division of tests of the Bureau of Public Roads has begun investigations in the vicinity of Washington to obtain accurate scientific information regarding the characteristics of soils which affect their bearing value.

The problem of avoiding road failures of the kind which can be traced to poor foundations seems to be possible of solution in one of the following ways:

1. Make the road surface thick enough to distribute pressure over an area of subgrade sufficiently wide to reduce the intensity of pressure to a degree capable of support by the subgrade.

2. By increasing the thickness of the road surface add to its inertia sufficiently to absorb a considerable amount of the shock of traffic.

3. Design road slabs to have sufficient strength to bridge over the soft subgrade.

4. Improve drainage so as to exclude moisture in dangerous amounts from soils, the bearing value of which is seriously affected by the presence of moisture.

It is perhaps true that all soils have adequate bearing value when the amount of water in them is kept within certain low limits; or, it may be possible that certain soils can be treated in some way which will improve their natural bearing value.

It is obvious that if knowledge of road construction is to be advanced first attention must be given to the road foundation, and accurate information must be obtained as to the properties of soils which make them good or poor soils for foundation purposes.

The investigations which have been begun in the vicinity of Washington are designed to yield information of this character; and it is now planned to extend the scope of the investigation by obtaining the cooperation of the various State highway departments.

A memorandum has been sent to each of the 13 district engineers of the bureau, describing the character of the information it is desired to obtain. Each of the engineers is asked to secure the cooperation of State highway departments and State geologists in obtaining samples of soil from subgrades, underlying sections of road which have failed apparently because of poor drainage or peculiar soil condition.

The samples are to be 1 cubic foot in volume, and each is to be taken from the subgrade, preferably directly under the failure. Accompanying the sample the engineers are asked to supply photographs of the site of the failure and complete information in regard to the topography of the vicinity, the character of the failure, the approximate amount of traffic, drainage conditions, the presence of water-bearing strata, or other conditions which might contribute to the failure of the subgrade. Particular emphasis is placed upon the necessity of showing how the water reached the subgrade, whether by vertical capillarity, horizontal capillarity, through seepage strata, or from the surface.

It is suggested that a 1½-inch auger will be useful for exploring the underlying soil, and that much useful information may be obtained by noting the texture and moisture content of the soil at different depths. Thus, if the soil at the surface is wet, and below it is very compact, dense, and dry, it may be assumed as probable that the water has entered the subgrade from the surface, and has been prevented from escaping by the underlying impervious layer. If, on the other hand, the underlying layer of a wet subgrade is wet and porous, and it in turn is underlain by a compact impervious clay which is dry, it would seem that the porous layer is a seepage stratum through which the water flows and rises to the upper layers of the subgrade by vertical capillarity. A number of combinations are to be expected, and each must be carefully studied to determine how the water which exists in the subgrade at the time of failure arrived there.

It is believed that observations of a large number of failures together with samples of the soil underlying them, and similar observations and samples pertaining to sections of the same roads which have not failed, will furnish a clue as to the causes of such failures and lead eventually to the discovery of proper remedies.

The investigation is now in its preliminary stages, and the data which is asked for at this time is designed only to serve as the ground work for a very far-reaching investigation which will follow, in which it is hoped to enlist the cooperation of State university laboratories, organizations of engineers, and individuals throughout the country.

# FEDERAL AID ALLOWANCES

PROJECT STATEMENTS APPROVED IN MARCH, 1920.

State.	Project No.	County.	Length in miles.	Type of construction.	Project statement approved.	Estimated cost.	Federal aid.
Alabama	69	Lamar	4.110	Gravel and earth	Mar. 2	<sup>1</sup> \$53,231.31	<sup>1</sup> \$26,615.65
Arkansas	69	Conway	6.020	Gravel	Mar. 3	59,771.80	12,500.00
	72	Lincoln	11.200	do	Mar. 19	27,270.98	7,040.00
	75	Dallas	21.750	do	do	62,224.74	30,000.00
	76	do	14.290	do	do	47,763.10	20,000.00
	83	Sevier	9.320	do	Mar. 26	37,206.12	18,600.00
	51	Conway	6.040	Bituminous surface	do	107,708.70	49,156.00
California	50	Fresno	8.070	Concrete	Mar. 5	159,958.70	79,979.35
	48	Santa Clara	8.130	do	Mar. 10	190,330.80	95,165.40
	52	Mendocino	17.800	do	do	454,821.40	227,410.70
	49	Santa Cruz	5.470	do	do	135,663.00	67,831.50
	15	San Diego	6.670	do	do	146,718.00	73,359.00
Colorado	51	Logan	.564	do	Mar. 3	19,945.20	9,972.60
	41	do	do	Bridges	Mar. 10	99,642.95	49,821.47
	83	Arapahoe	2.714	Concrete	Mar. 26	108,511.92	54,255.96
	109	Mesa	.977	do	Mar. 27	40,902.51	19,540.00
	35	Weld	1.228	Gravel	Mar. 26	49,364.61	24,560.00
Georgia	50	Elbert	16.880	Earth	Mar. 10	<sup>2</sup> 48,446.75	<sup>2</sup> 24,223.37
	110	Morgan	4.626	Concrete	Mar. 19	86,815.30	43,058.03
	125	Lee	14.000	Sand-clay	do	91,026.24	20,000.00
Idaho	31	Benewah	10.900	Gravel	Mar. 3	197,806.40	98,903.20
	36	Franklin	21.800	do	Mar. 5	159,999.40	79,999.70
	34	Oneida	7.000	do	do	49,997.20	24,998.60
	43	Bonneville	2.850	Concrete	Mar. 26	93,150.00	46,575.00
	22	do	3.000	do	Mar. 24	<sup>2</sup> 93,150.20	<sup>2</sup> 46,575.10
Indiana	20	Ripley	.977	do	Mar. 10	49,690.37	19,540.00
	21	Clark, Scott, and Jackson	44.700	Concrete, brick, or bituminous	Mar. 19	1,900,000.00	894,000.00
Iowa	114	Scott	17.230	Concrete or brick	Mar. 2	968,948.20	344,600.00
	117	Humboldt	40.830	Earth	do	49,830.00	24,900.00
	102	North Liberty	18.200	do	Mar. 5	61,875.00	30,900.00
	132	Polk	29.200	Paved surface	Mar. 26	1,614,277.50	584,000.00
Kansas	46	Shawnee	9.480	Concrete, brick, or bituminous macadam	Mar. 2	577,775.00	142,200.00
	48	Jefferson	10.750	Brick, concrete, or bituminous macadam	do	745,581.10	95,000.00
	49	Ottawa	5.500	Brick or concrete	Mar. 4	403,755.00	81,250.00
	50	Bourbon	.521	Bituminous macadam	Mar. 8	16,182.52	7,815.00
	42	Mead	5.000	Earth	Mar. 10	50,567.00	25,283.50
Kentucky	51	Franklin	.830	Concrete or brick	Mar. 26	52,734.00	6,000.00
	21	Bell	10.000	Bituminous macadam	Mar. 8	144,444.44	72,222.22
	23	Whitley	33.000	Water-bound macadam	Mar. 9	174,259.36	87,129.68
	24	Jessamine	3.000	Macadam	Mar. 19	35,222.00	17,611.00
	25	Washington	2.500	Macadam or bituminous surface	Mar. 26	49,912.50	24,956.25
Maine	26	Jefferson	11.100	Macadam or asphalt	do	432,342.53	216,171.26
	6	Aroostook	5.870	Gravel	Mar. 5	79,585.00	39,792.50
	7	do	3.690	do	do	49,720.00	24,860.00
	8	Waldo	2.540	Bituminous macadam	do	118,094.90	59,047.45
	9	Cumberland	4.720	Concrete	do	206,280.14	98,998.00
	10	do	2.520	Bituminous macadam	do	107,870.67	50,400.00
	11	do	7.080	Concrete or bituminous macadam	do	280,519.80	140,259.90
	12	do	6.640	do	do	274,341.98	132,800.00
	13	Androscoggin	1.570	do	do	67,135.75	31,400.00
	14	Penobscot	4.710	Bituminous macadam	do	165,839.74	82,919.87
	15	do	7.440	do	do	262,870.30	131,435.15
	16	do	4.080	do	do	149,029.98	74,514.99
	17	Piscataquis	2.060	Gravel	do	30,580.55	15,290.27
	20	Somerset	1.480	Bituminous macadam	do	44,308.11	22,154.05
	21	do	6.440	do	do	226,693.83	113,346.91
	26	Cumberland	3.920	do	do	107,867.54	53,933.77
	27	do	8.640	do	do	264,772.75	132,386.37
	33	Waldo	do	Bridge	do	330,000.00	165,000.00
	19	Franklin	2.690	Gravel	Mar. 8	50,270.22	25,135.11
Maryland	18	do	3.938	do	Mar. 10	91,329.48	45,664.74
	38	Worcester	3.625	Concrete	Mar. 2	137,500.00	68,750.00
	39	Dorchester	2.350	do	Mar. 26	77,473.71	38,736.85
	32	St. Marys	<sup>3</sup> 3.400	Gravel	Mar. 8	<sup>3</sup> 40,817.70	<sup>3</sup> 20,408.85
	36	Anne Arundel	<sup>3</sup> 8.410	Concrete	Mar. 11	<sup>3</sup> 359,630.37	<sup>3</sup> 165,981.41
Minnesota	154	Morrison	9.410	Brick, concrete, or asphalt	Mar. 3	286,570.41	143,285.20
	137	Fillmore	6.250	Gravel	Mar. 4	24,750.00	12,375.00
	149	Aitkin	9.300	do	do	48,004.00	24,002.00
	130	Big Stone	9.420	do	Mar. 5	81,686.00	40,843.00
	146	Lincoln	13.670	do	Mar. 8	105,166.60	52,583.30
	160	Otter Tail	11.400	do	Mar. 10	101,222.00	50,611.00
	142	Cass	7.930	do	Mar. 19	71,801.40	35,900.70
	147	Houston	21.800	do	Mar. 26	254,914.00	127,457.00
	96	Winona	4.610	Concrete, brick, or asphalt	do	182,997.72	91,498.86
	159	Otter Tail	9.500	Gravel	do	60,500.00	30,250.00
Mississippi	93	Pearl River	13.000	do	Mar. 2	110,041.80	55,020.90
	75	Chickasaw	5.810	do	Mar. 10	76,780.00	38,390.00
Missouri	90	Texas	28.310	do	Mar. 4	136,122.00	68,061.00
	91	Ripley	11.000	do	Mar. 5	50,373.40	25,186.70
Montana	75	Gallatin	2.000	do	Mar. 3	9,814.20	4,907.10
	77	Lewis and Clark	8.500	Gravel and concrete	do	74,135.05	37,067.52
	82	Gallatin	6.500	Cement or bituminous concrete	do	248,792.50	124,396.25
	89	Flathead	4.000	Gravel	Mar. 4	19,976.00	9,988.00
	86	Gallatin	5.800	do	Mar. 5	37,459.40	18,729.70
	76	Fallon	35.700	Sand-clay	do	123,961.81	64,980.90
	91	Musselshell	1.350	Concrete	do	60,154.60	27,000.00
	100	Flathead	4.500	Gravel	Mar. 10	17,902.50	8,951.25
	61	Wibaux	6.850	do	Mar. 19	32,041.46	16,020.73
	93	Flathead	3.500	do	do	16,307.50	8,153.75
	79	Roosevelt	do	Bridge	do	15,400.00	7,700.00
	21	Missoula	7.000	Gravel	Mar. 11	<sup>2</sup> 21,995.60	<sup>2</sup> 10,997.80
	24	Blaine	5.000	do	Mar. 8	<sup>2</sup> 15,397.80	<sup>2</sup> 7,698.90
	38	do	6.000	do	do	22,000.00	11,000.00

<sup>1</sup> Revised statements. Amounts given are increases over those in the original statement.

<sup>2</sup> Withdrawn.

<sup>3</sup> Revised statements. Amounts given are decreases over those in the original statement.

## PROJECT STATEMENTS APPROVED IN MARCH, 1920—Continued.

State.	Project No.	County.	Length in miles.	Type of construction.	Project agreement signed.	Estimated cost.	Federal aid.
Nebraska	139	Madison, Antelope, and Holt.	62.600	Sand-clay or gravel.	Mar. 2	\$253,668.80	\$126,834.40
	132	Holt, Garfield, and Wheeler.	74.800	Earth and sand-clay.	Mar. 8	283,580.00	141,790.00
	135	Merrick	17.400	Gravel.	Mar. 26	67,235.52	33,617.76
New Jersey	25	Atlantic and Burlington.	2.253	do.	Mar. 2	88,044.65	44,022.32
	26	Monmouth	6.380	Concrete.	do.	306,529.85	127,600.00
	20	Middlesex.	do.	Bridge.	do.	2,637,536.00	1,147,048.72
New Mexico	47	Grant	15.270	Gravel.	Mar. 19	94,490.66	47,245.33
	48	Chaves	15.000	do.	do.	128,342.50	64,171.25
New York	47	Delaware	12.900	Concrete.	do.	516,000.00	258,000.00
North Carolina	114	Rowan	2.550	Bituminous.	Mar. 2	92,927.89	46,463.94
	122	Durham	5.650	Concrete or bituminous macadam.	do.	219,762.18	109,881.09
	123	Craven	8.300	Concrete or hard surface.	do.	296,259.70	148,129.85
	116	Stanley and Montgomery	do.	Bridge.	Mar. 3	121,275.00	60,637.50
	127	Wilson	8.100	Sand-clay and gravel.	Mar. 19	62,535.00	31,267.50
North Dakota	91	Emmons	10.500	Earth.	Mar. 4	33,495.00	16,747.50
Ohio	113	Williams	1.187	Bituminous.	Mar. 19	55,402.65	20,000.00
	112	Jackson	2.332	Concrete or bituminous surface.	Mar. 26	125,000.00	42,500.00
	118	Wood	3.378	Concrete.	do.	157,400.00	20,000.00
	111	Delaware	7.420	Concrete or bituminous macadam.	do.	312,000.00	60,000.00
	114	Williams	2.580	Bituminous macadam.	do.	68,983.76	14,000.00
	136	Clermont	2.542	Water-bound or bituminous macadam.	do.	73,100.00	35,000.00
	138	do.	4.820	do.	do.	154,700.00	70,000.00
Oklahoma	17	Grady	do.	Bridge.	Mar. 4	294,135.38	147,067.69
	20	Kay	17.278	Brick or concrete.	Mar. 8	725,259.83	324,156.82
Oregon	37	Wasco	12.500	Earth.	Mar. 9	265,113.75	132,556.87
	27	Columbia	10.850	Bitulithic.	Mar. 26	252,466.50	126,233.25
	40	Wallowa	8.390	Earth.	do.	115,555.00	57,777.50
South Carolina	81	Charleston	7.384	Concrete.	Mar. 3	321,524.94	102,000.00
	83	Union	7.074	Topsoil.	Mar. 9	53,441.02	5,295.89
	67	Lee	18.114	Sand-clay.	Mar. 19	257,035.60	21,750.00
South Dakota	46	Hamlin	15.750	Gravel.	Mar. 2	107,701.00	53,850.50
	51	Gregory	16.000	Earth.	do.	69,289.00	34,644.50
Tennessee	49	Lyman & Brule.	8.950	Gravel.	Mar. 10	77,518.10	38,759.05
	27	Lewis and Lawrence	20.466	Earth.	Mar. 19	88,282.92	44,141.46
	33	Crockett	5.666	Bituminous surface.	do.	133,669.58	66,834.79
Texas	136	Kaufman	35.060	Gravel.	Mar. 2	505,002.30	138,000.00
	128	Montague	24.000	Gravel and sand-clay.	Mar. 3	180,180.00	60,000.00
	129	Milam	8.769	Gravel.	Mar. 19	68,368.13	25,000.00
	138	Limestone	11.917	Macadam.	do.	187,298.43	48,000.00
	140	Williamson	30.500	Gravel.	Mar. 26	219,992.30	100,000.00
	122	Hill	27.000	do.	Mar. 11	2315,182.23	240,000.00
	49	do.	213.700	do.	Mar. 27	243,709.60	21,854.80
	123	Hill	212.820	Gravel.	Mar. 11	2145,370.70	225,000.00
Utah	29	Sanpete.	11.400	Hard surface.	Mar. 5	435,684.70	217,842.35
Vermont	13	Addison	4.070	Macadam or gravel.	Mar. 19	122,173.92	61,086.96
Virginia	70	Campbell	4.300	Bituminous macadam.	Mar. 2	110,000.00	55,000.00
	56	Tazewell	5.560	Gravel.	Mar. 19	83,765.00	41,882.50
	67	Dickenson	5.927	Macadam.	do.	97,006.25	48,503.12
	81	Henrico	2.960	Bituminous.	do.	73,150.00	36,575.00
Washington	53	Stevens.	5.990	Gravel.	Mar. 3	87,044.10	40,000.00
	52	do.	7.720	Gravel or crushed rock.	Mar. 5	106,605.62	50,000.00
	51	Pierce.	4.270	Concrete.	Mar. 19	184,772.72	85,400.00
	55	Thurston	6.210	do.	do.	273,730.32	124,200.00
	57	do.	1.990	do.	do.	70,915.62	35,457.81
	56	Walla Walla	3.410	do.	do.	143,125.97	68,200.00
West Virginia	54	Grays Harbor.	3.640	Earth.	Mar. 26	52,862.04	26,431.02
	85	Roane	3.000	Concrete.	Mar. 8	67,200.00	27,200.00
	86	Mingo.	3.020	Earth.	Mar. 19	52,580.00	21,600.00
	90	Wood	2.000	Concrete.	do.	70,400.00	32,001.00
	87	Mason	4.500	Gravel.	Mar. 26	58,850.00	28,520.00
	88	Wayne.	2.800	Earth.	do.	47,300.00	23,650.00
Wisconsin	115	Walworth.	4.720	Concrete.	Mar. 2	196,965.32	77,465.00
	140	Iowa	8.270	Earth.	do.	65,103.04	25,000.00
	154	Fond du Lac and Milwaukee.	3.590	Concrete.	Mar. 3	122,145.71	46,650.00
	137	Fayette	1.530	Earth.	Mar. 5	27,486.29	10,000.00
	157	Green Lake.	.610	Concrete.	do.	20,013.14	7,434.34
	116	Winnebago.	6.270	do.	Mar. 10	207,000.00	70,500.00
	129	Marinette.	7.820	Earth.	do.	75,479.75	28,000.00
	139	Brown	2.910	Concrete.	do.	98,174.89	30,000.00
	150	Dodge	6.450	do.	do.	262,867.55	87,622.51
	145	Clark	3.700	Macadam.	Mar. 19	35,692.25	11,000.00
	164	La Crosse.	2.090	Concrete.	do.	98,999.05	34,500.00
	155	Forest	3.180	Gravel.	do.	30,000.00	10,500.00
	147	Clark	5.580	do.	Mar. 26	44,607.36	15,200.00
	61	Sauk	.760	do.	do.	23,657.62	9,000.00
	122	Pierce.	10.400	do.	do.	100,068.45	36,268.00
	76	Portage	26.370	do.	Mar. 27	231,019.23	210,339.74
Wyoming	68	Hot Springs.	4.281	Selected material.	Mar. 2	52,360.00	26,180.00
	50	Lincoln	2.639	Gravel.	Mar. 19	25,300.00	12,650.00
	70	Washakie.	2.902	Selected material.	Mar. 26	26,290.00	13,145.00
	71	do.	3.125	do.	do.	22,440.00	11,220.00

## PROJECT AGREEMENTS EXECUTED IN MARCH, 1920.

Alabama	70	Barbour	3.010	Sand-clay	Mar. 4	\$27,552.53	\$13,776.26
	64	Fike	13.970	Sand-clay and gravel.	Mar. 26	115,535.25	57,767.62
	56	Jefferson	do.	Bituminous concrete.	do.	119,240.07	19,620.03
Arizona	17	Yavapai	5.000	Broken stone.	Mar. 22	210,347.26	100,000.00
	1	Pinal	do.	Reinforced concrete or brick	do.	17,778.50	13,880.25
Arkansas	58	Hempstead	5.020	Gravel.	Mar. 26	34,897.98	12,500.00
	32	do.	do.	do.	Mar. 11	do.	12,000.00
Colorado	28	Summit	2.093	Earth.	Mar. 17	34,994.42	17,497.21
	31	Adams and Arapahoe	1.161	Concrete.	do.	43,603.64	21,801.82
	29	Jefferson	1.946	Earth.	do.	59,751.58	29,875.79

<sup>1</sup> Modified agreements. Amounts given are increases over those in the original agreement.<sup>2</sup> Withdrawn.

## PROJECT AGREEMENTS EXECUTED IN MARCH, 1920—Continued.

State.	Project No.	County.	Length in miles.	Type of construction.	Project agreement signed.	Estimated cost.	Federal aid.	
Georgia	82	Lumpkin	7.960	Gravel or crushed stone	Mar. 4	\$77,441.25	\$38,720.62	
	23	Forsythe	11.309	Topsoil	do	63,723.45	25,000.00	
	74	Sumter	do	Bridge	do	39,456.08	15,000.00	
	96	Floyd	7.245	Bituminous macadam	do	101,406.25	50,000.00	
	97	Troup	5.130	Topsoil	do	61,359.06	26,668.15	
	54	Chatham	2.848	Bituminous concrete	Mar. 20	101,126.69	50,563.34	
	77	Chatham	19.240	Gravel	Mar. 24	276,944.23	138,472.11	
	103	Chatham	3.306	Concrete	Mar. 6	111,736.15	50,000.00	
	101	Sumter	3.000	Bituminous macadam	Mar. 20	79,968.17	39,984.08	
	35	Whitfield	5.834	Chert	Mar. 13	52,069.80	26,034.90	
	64	Glynn	4.370	do	Mar. 19	103,728.70	51,864.35	
	24	Cherokee	.997	Topsoil road	do	<sup>2</sup> 11,159.23	<sup>2</sup> 5,657.54	
	Illinois	1-22, 21	Kane, Dupage	2.821	Concrete	Mar. 4	80,367.26	40,183.62
		5 F	Peoria	.587	do	do	23,415.21	11,707.60
1, 1-5, 8-18		Reno	1.304	do	do	<sup>1</sup> 34,834.75	<sup>1</sup> 17,417.38	
Kansas	27 I	Reno	.214	do	do	7,104.46	3,210.60	
	27 A, B, C, D, E, F, G	do	34.964	Brick	do	2,137,332.00	524,460.00	
	30 B	Lyon	4.489	do	Mar. 5	203,212.17	67,335.00	
	41	Achison	8.572	Concrete or brick	Mar. 26	553,860.67	128,580.00	
Kentucky	7 A-B	Hart	3.285	Macadam	Mar. 13	68,007.72	34,003.86	
	10 A	Larue	2.974	do	do	63,999.94	31,999.97	
Maryland	36	Anne Arundel	.590	Concrete	Mar. 21	36,369.63	14,018.59	
Minnesota	111	Redwood	1.970	Gravel	Mar. 2	8,274.47	4,000.00	
	13	do	do	Mar. 26	<sup>1</sup> 51,648.41	<sup>1</sup> 28,000.00		
	38	Mower	do	Gravel	Mar. 5	<sup>1</sup> 50,298.15	<sup>1</sup> 30,000.00	
Mississippi	21	Lowndes	7.320	do	Mar. 4	53,160.47	26,580.23	
	47	Holmes	3.710	do	Mar. 3	24,236.63	12,118.31	
	28	Lowndes	5.364	do	Mar. 19	76,489.32	38,244.66	
	9	Kemper	do	do	Mar. 3	<sup>2</sup> 9,960.50	<sup>2</sup> 4,980.25	
Missouri	31	Washington	3.530	Gravel	Mar. 9	14,405.09	7,202.54	
	22	Randolph	1.669	Brick or concrete	do	56,086.71	28,043.35	
	6	Clay	10.520	Bituminous macadam	Mar. 20	274,443.01	68,610.75	
	19	Jackson	2.390	Concrete or asphalt concrete	Mar. 26	115,906.18	47,800.00	
	25	Clay	13.050	Bituminous macadam	do	355,716.90	177,858.45	
	54	Cass	.860	Gravel	do	5,855.30	<sup>2</sup> 927.65	
Montana	60 A	Howard	7.580	Earth and sand-clay	Mar. 3	53,151.68	26,575.84	
	52	Pheps	9.979	Clay-gravel	Mar. 22	45,462.43	22,731.21	
	66	Cherry	24.560	Sand-clay	do	227,505.33	113,752.66	
	22	Custer	31.870	do	Mar. 30	201,960.90	100,980.45	
New Hampshire	32	Rockingham	1.290	Gravel surface-treated	Mar. 3	10,066.95	5,033.47	
	52	Sullivan	1.060	Gravel	do	14,790.00	7,395.00	
	59	Cheshire	.870	Water-bound macadam	do	18,995.18	9,497.59	
New Mexico	1 B	Colfax	14.370	Gravel	Mar. 5	157,492.41	78,746.20	
	46	Santa Fe	.572	do	Mar. 13	10,326.59	5,163.29	
	19	Luna	11.676	do	Mar. 26	85,399.20	42,699.60	
New York	12	Cortland	6.540	Reinforced concrete	do	261,600.00	130,800.00	
	5	Columbia	do	Concrete	do	<sup>3</sup> 18,945.40	<sup>3</sup> 9,472.70	
	74 A	Stanley	2.083	Topsoil	Mar. 6	23,390.30	11,695.15	
	85	Davie	8.280	do	do	45,188.39	22,594.19	
	48 A	Northampton	5.804	Gravel on sand-clay base	Mar. 9	58,814.38	29,407.19	
North Carolina	46	Beaufort	.720	Concrete	Mar. 31	27,450.26	13,725.13	
	52	Cabarrus	8.986	Topsoil	do	130,960.19	65,480.09	
	56	Forsyth	5.868	Topsoil or gravel	do	62,054.85	31,027.43	
	99	Chatham	12.650	Topsoil	do	94,269.56	47,134.78	
	22	Alamance	.760	Concrete and bituminous macadam	do	<sup>1</sup> 246,023.92	<sup>1</sup> 132,589.68	
	17	Wilkes	do	Earth road	Mar. 19	do	<sup>1</sup> 25,000.00	
	12	Wayne	.390	Sand-clay gravel	Mar. 26	<sup>1</sup> 27,294.53	<sup>1</sup> 5,000.00	
	98	Jefferson	2.327	Brick	Mar. 4	114,000.00	46,540.00	
	87	Champaign	5.068	Brick or reinforced concrete	Mar. 13	205,200.00	50,700.00	
	90	Jackson	2.478	Bituminous macadam	Mar. 10	43,000.00	20,000.00	
	81	Pickaway	4.092	do	Mar. 18	100,000.00	50,000.00	
Oklahoma	4	Comanche	.020	Concrete	Mar. 26	<sup>1</sup> 20,185.80	<sup>1</sup> 10,092.90	
	10	Marion	4.160	Asphalt concrete	Mar. 2	112,931.06	56,465.53	
Oregon	23	Lake	1.780	Gravel	Mar. 3	9,334.05	4,667.02	
	38	Umatilla	7.540	do	Mar. 9	107,926.98	53,963.49	
	6	Wheeler and Grant	49.250	Earth	Mar. 19	728,136.60	364,068.30	
	7	Marion	do	Bituminous concrete	Mar. 3	<sup>1</sup> 28,151.75	<sup>1</sup> 31,397.72	
South Carolina	46	Kershaw	2.130	Gravel	Mar. 20	23,208.99	11,604.49	
	47	Florence	5.982	Concrete	Mar. 15	220,282.68	84,900.54	
	7	Horry	do	Sand-clay	Mar. 5	<sup>1</sup> 39,327.70	<sup>1</sup> 19,663.85	
South Dakota	23	Jackson and Washabaugh	do	Bridge	Mar. 13	28,029.47	14,014.73	
	27	Lyman and Tripp	do	do	Mar. 30	36,875.03	18,437.51	
Tennessee	12	Union-Claiborne	13.639	Macadam	Mar. 5	296,860.42	148,430.21	
	13	Carroll	2.791	Chert	Mar. 17	35,939.82	17,969.91	
Texas	37	Fayette	11.270	Gravel	Mar. 8	144,827.27	61,773.00	
	15	Wharton	5.900	do	Mar. 5	97,623.15	20,250.00	
	110	McLennan	1.010	Concrete	Mar. 20	41,777.54	20,200.00	
	3	Wichita	do	Bituminous-treated gravel	Mar. 22	<sup>1</sup> 111,047.99	<sup>1</sup> 25,741.25	
Virginia	61	do	do	Mar. 23	<sup>1</sup> 344,901.43	<sup>1</sup> 18,800.36		
	45	Henry	4.469	Topsoil	Mar. 12	74,194.67	37,097.33	
	54	Rockbridge	2.059	Water-bound macadam	do	44,084.59	22,042.29	
West Virginia	57	Cabell	1.000	Brick	Mar. 13	42,101.48	19,200.00	
	72	Hampshire	.500	Earth	do	6,300.00	3,150.00	
	29	Ritchie	do	Concrete	Mar. 5	do	<sup>1</sup> 31,360.00	
Wisconsin	56	Jackson	.350	do	Mar. 13	15,500.00	6,500.00	
	34	Iowa	do	Earth	Mar. 1	<sup>1</sup> 3,414.94	<sup>1</sup> 1,138.31	
Wyoming	25	Crook	19.580	Gravel	Feb. 28	171,479.77	85,739.88	
	32	Fremont	do	Bridges	do	45,815.79	22,907.89	
	33	Albany	2.158	Water-bound macadam	do	30,464.43	15,232.21	
	17	Uinta	3.832	Sand-clay	Mar. 13	21,423.98	10,711.99	
	36	Albany	14.928	Gravel	do	36,593.20	15,296.60	
	39	Big Horn	8.161	do	do	69,950.43	34,975.21	
	47	Fremont	do	Bridge	do	13,712.51	6,856.25	

<sup>1</sup> Modified agreements. Amounts given are increases over those in the original agreement.

<sup>2</sup> Revised agreements. Increase.

<sup>3</sup> Modified agreement. Amounts given are decreases over those in the original agreement.

# ROAD PUBLICATIONS OF BUREAU OF PUBLIC ROADS.

*Applicants are urgently requested to ask only for those publications in which they are particularly interested. The Department can not undertake to supply complete sets, nor to send free more than one copy of any publication to any one person. The editions of some of the publications are necessarily limited, and when the Department's free supply is exhausted and no funds are available for procuring additional copies, applicants are referred to the Superintendent of Documents, Government Printing Office, this city, who has them for sale at a nominal price, under the law of January 12, 1895. Those publications in this list, the Department supply of which is exhausted, can only be secured by purchase from the Superintendent of Documents, who is not authorized to furnish publications free.*

## REPORTS.

- \*Report of the Director of the Office of Public Roads for 1916. 5c.
- \*Report of the Director of the Office of Public Roads for 1917. 5c.
- Report of the Director of the Bureau of Public Roads for 1918.
- Report of the Chief of the Bureau of Public Roads for 1919.

## DEPARTMENT BULLETINS.

- Dept. Bul. 105. Progress Report of Experiments in Dust Prevention and Road Preservation, 1913.
  - 136. Highway Bonds.
  - 220. Road Models.
  - 230. Oil Mixed Portland Cement Concrete.
  - 249. Portland Cement Concrete Pavements for Country Roads.
  - 257. Progress Report of Experiments in Dust Prevention and Road Preservation, 1914.
  - 314. Methods for the Examination of Bituminous Road Materials.
  - 347. Methods for the Determination of the Physical Properties of Road-Building Rock.
  - \*348. Relation of Mineral Composition and Rock Structure to the Physical Properties of Road Materials. 10c.
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  - 373. Brick Roads.
  - 386. Public Road Mileage and Revenues in the Middle Atlantic States, 1914.
  - 387. Public Road Mileage and Revenues in the Southern States, 1914.
  - 388. Public Road Mileage and Revenues in the New England States 1914.
  - 389. Public Road Mileage and Revenues in the Central, Mountain, and Pacific States, 1914.
  - 390. Public Road Mileage in the United States, 1914. A Summary.
  - 393. Economic Surveys of County Highway Improvement.
  - 407. Progress Reports of Experiments in Dust Prevention and Road Preservation, 1915.
  - 414. Convict Labor for Road Work.
  - 463. Earth, Sand-Clay, and Gravel Roads.
  - 532. The Expansion and Contraction of Concrete and Concrete Roads.
  - 537. The Results of Physical Tests of Road-Building Rock in 1916, Including all Compression Tests.
  - 555. Standard Forms for Specifications, Tests, Reports, and Methods of Sampling for Road Materials.
  - 583. Reports on Experimental Convict Road Camp, Fulton County, Ga.
  - 586. Progress Reports of Experiments in Dust Prevention and Road Preservation, 1916.
  - 660. Highway Cost Keeping.
  - 670. The Results of Physical Tests of Road-Building Rock in 1916 and 1917.
  - 691. Typical Specifications for Bituminous Road Materials.
  - 704. Typical Specifications for Nonbituminous Road Materials.
  - 724. Drainage Methods and Foundations for County Roads.
- Public Roads, Vol. I, No. 11. Tests of Road-Building Rock in 1918.

## OFFICE OF PUBLIC ROADS BULLETINS.

- Bul. \*37. Examination and Classification of Rocks for Road Building, Including Physical Properties of Rocks with Reference to Their Mineral Composition and Structure. (1911.) 15c.
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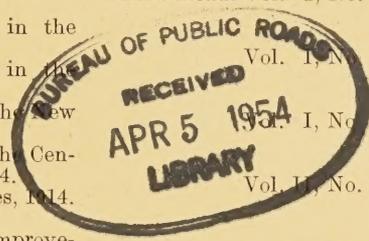
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## OFFICE OF PUBLIC ROADS CIRCULARS.

- Cir. 89. Progress Report of Experiments with Dust Preventatives, 1907.
- \*90. Progress Report of Experiments in Dust Prevention, Road Preservation, and Road Construction, 1908. 5c.
- \*92. Progress Report of Experiments in Dust Prevention and Road Preservation, 1909. 5c.
- \*94. Progress Reports of Experiments in Dust Prevention and Road Preservation, 1910. 5c.
- 98. Progress Reports of Experiments in Dust Prevention and Road Preservation, 1911.
- \*99. Progress Reports of Experiments in Dust Prevention and Road Preservation, 1912. 5c.
- \*100. Typical Specifications for Fabrication and Erection of Steel Highway Bridges. (1913.) 5c.

## OFFICE OF THE SECRETARY CIRCULARS.

- Sec. Cir. 49. Motor Vehicle Registrations and Revenues, 1914.
- 52. State Highway Mileage and Expenditures to January 1, 1915.
- 59. Automobile Registrations, Licenses, and Revenues in the United States, 1915.
- 63. State Highway Mileage and Expenditures to January 1, 1916.
- 65. Rules and Regulations of the Secretary of Agriculture for Carrying out the Federal Aid Road Act.
- 72. Width of Wagon Tires Recommended for Loads of Varying Magnitude on Earth and Gravel Roads.
- 73. Automobile Registrations, Licenses, and Revenues in the United States, 1916.
- 74. State Highway Mileage and Expenditures for the Calendar Year 1916.
- 77. Experimental Roads in the Vicinity of Washington, D. C.
- Public Roads Vol. I, No. 1. Automobile Registrations, Licenses, and Revenues in the United States, 1917.
- Vol. I, No. 3. State Highway Mileage and Expenditures in the United States, 1917.
- Vol. I, No. 11. Automobile Registrations, Licenses, and Revenues in the United States, 1918.
- Vol. II, No. 15. State Highway Mileage and Expenditures in the United States, 1918.



## FARMERS' BULLETINS.

- F. B. 338. Macadam Roads.
- \*505. Benefits of Improved Roads. 5c.
- 597. The Road Drag.

## SEPARATE REPRINTS FROM THE YEARBOOK.

- Y. B. Sep. \*638. State Management of Public Roads; Its Development and Trend. 5c.
- 727. Design of Public Roads.
- 739. Federal Aid to Highways, 1917.

## REPRINTS FROM THE JOURNAL OF AGRICULTURAL RESEARCH.

- Vol. 5, No. 17, D- 2. Effect of Controllable Variables Upon the Penetration Test for Asphalts and Asphalt Cements.
- Vol. 5, No. 19, D- 3. Relation Between Properties of Hardness and Toughness of Road-Building Rock.
- Vol. 5, No. 20, D- 4. Apparatus for Measuring the Wear of Concrete Roads.
- Vol. 5, No. 24, D- 6. A New Penetration Needle for Use in Testing Bituminous Materials.
- Vol. 6, No. 6, D- 8. Tests of Three Large-Sized Reinforced Concrete Slabs Under Concentrated Loading.
- Vol. 10, No. 5, D-12. Influence of Grading on the Value of Fine Aggregate Used in Portland Cement Concrete Road Construction.
- Vol. 10, No. 7, D-13. Toughness of Bituminous Aggregates.
- Vol. 11, No. 10, D-15. Tests of a Large-Sized Reinforced-Concrete Slab Subjected to Eccentric Concentrated Loads.
- Vol. 17, No. 4, D-16. Ultra-Microscopic Examination of Disperse Colloids Present in Bituminous Road Materials.

\* Department supply exhausted.





